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EMERSON McMILLIN

BORN, EWINGTON, OHIO, APRIL 16, 1844

DIED, DARLINGTON, MAHWAH, NEW JERSEY, MAY 31, 1922

Soldier, merchant, contractor, manager, banker; early an investigator, always a patron of scientific research; member of the Ohio Academy of Science since 1892.

In the death of Mr. McMillin the Ohio Academy of Science has lost a member whose loyalty has not flagged during a quarter century of absence from the State, and whose scientific sympathy and generous financial support have contributed in a notable degree to the research work of the Academy and its membership.

A more adequate memorial will be presented at the next Annual Meeting of the Academy.

REPORT OF THIRTY-SECOND ANNUAL MEETING OF THE OHIO ACADEMY OF SCIENCE

The Thirty-second Annual Meeting of the Ohio Academy of Science was held at Ohio State University, Columbus, April 14 and 15, 1922, under the Presidency of Professor Raymond C. Osburn. Eighty-seven members were registered as in attendance; forty-six new members were elected.

On invitation of the geologists of the Michigan Academy of Science, a number of the members of the Geological Section of the Ohio Academy, under the Vice-Presidency of Professor Kirtley F. Mather, participated in a joint field meeting, held June 3 and 4, for the study of the glacial geology and Silurian rocks of Southeastern Michigan and adjoining portions of Ontario. The party was under the leadership of Mr. Frank Leverett, of the University of Michigan, and Professor W. H. Sherzer, of the Michigan State Normal College. Professor J. E. Carman, of Ohio State University, collaborated in directing the investigations at certain localities.

General Program.

Friday, April 14.

9:30 A. M.—Business Meeting.

11:00 A. M.—Reading of Papers in General Session.

12:30 P. M.—Luncheon.

2:00 P. M.—Demonstrations.

2:30 P. M.—Joint session with the Ohio State University Chapter of Sigma Xi; Illustrated Lecture by Professor L. R. Jones, of the University of Wisconsin, on "Disease and Disease Resistance in Plants."

3:30 P. M.—Reading of Papers in Sectional Meetings.

6:00 P. M.—Dinner.

7:30 P. M.—Address by the President of the Academy, Professor Raymond C. Osburn, Ohio State University, on "Some Common Misconceptions of Evolution."

9:00 P. M.—Adjourned Business Meeting.

SATURDAY, APRIL 15.

9:00 A. M.—Adjourned Business Meeting.
10:00 A. M.—Illustrated Lecture by Professor Dayton C. Miller, Case School of Applied Science, on "Ether-Drift Experiments at Mount Wilson, California."
11:00 A. M.—Reading of Papers in General Session.
12:30 P. M.—Luncheon.
2:00 P. M.—Demonstrations.
2:30 P. M.—Reading of Papers in Sectional Meetings.

SATURDAY, JUNE 3, and SUNDAY, JUNE 4.

Joint Excursion of Section for Geology, with Geologists of Michigan Academy of Science.

MINUTES OF BUSINESS MEETINGS.

The first business session was called to order by President Osburn at 9:30 A. M., on Friday, April 14. Adjourned sessions were held after the presidential address on Friday evening and at 9:00 A. M. on the following day.

The appointment of the following committees for the meeting was announced by the chair:

Committee on Membership—A. P. Weiss, W. G. Stover, F. C. Blake.

Committee on Resolutions—S. I. Kornhauser, Stephen R. Williams, L. G. Westgate.

Committee on Necrology—G. D. Hubbard, Herbert Osborn, F. L. Landacre.

The following Auditing Committee was elected by the Academy: M. E. Stickney, F. L. Landacre.

The following Nominating Committee was elected by the ballot of the Academy: W. M. Barrows, W. G. Stover, G. D. Hubbard, Alpheus W. Smith, F. L. Landacre, H. E. Burtt.

Report of the Secretary.

The following report by the Secretary was received and ordered filed.

April 4, 1922.

To the Ohio Academy of Science:

The work of the Secretary for the year has been largely routine, but a few items are of some general interest.

A brief report of the Thirty-first Annual Meeting was prepared for *Science*, and appeared in the issue for September 23.

The Secretary was present to represent the Academy at the meetings of the Council of the American Association for the Advancement of Science, held in connection with the Toronto meeting.

The blank form for nomination of fellows was prepared, as directed, and mailed to all members in connection with the preliminary announcement of this meeting. The certificate of election to fellowship is in preparation; a proof was submitted to the Executive Committee for suggestion and criticism at the meeting of April 13.

The following letter was received from the Wisconsin Academy of Science, Arts and Letters:

Sept. 15, 1921.

The Secretary, Ohio Academy of Science, Columbus, Ohio.

My Dear Sir: We take great pleasure in sending to your institution, under separate cover, the bronze medallion issued in 1920 in commemoration of the fiftieth anniversary of the founding of the Wisconsin Academy, 1870–1920.

We ask you to accept it with our fraternal greetings.

A brief description of the medallion, with a short statement of its significance, is sent with the medallion itself. A fuller account is printed in the Fiftieth Anniversary volume, Volume XX of the Transactions of the Academy.

Yours very truly,

Chancey Juday, *Secretary.*

The medallion was duly acknowledged, and has been placed with the archives of the Academy in the Library Building.

A letter from V. A. Latham, corresponding secretary of the State Microscopical Society of Illinois, contains the following sentences, asking for the co-operation of members of the Academy:

"Is there any one you know of who might have duplicates of Scientific Journals, especially Microscopy? We are anxious to complete ours and the John Crerar Library, and any help through your Academy would be appreciated. We had so many former microworkers in your state who were members." Dr. Latham may be addressed at 1644 Morse Ave., Rogers Park, Chicago.

Several years ago the Secretary suggested the desirability of concentrating the administrative work of the Academy in Columbus by the election of a Columbus man as secretary. This suggestion may well be repeated at this time. The increase in membership, the organization of new sections, and the affiliation with the American Association for the Advancement of Science have so materially increased the routine work of the secretary and treasurer that the Academy should look forward in the very near future to the organization of a regular Academy headquarters in Columbus, with salaried secretary and treasurer, or, probably better, a secretary-treasurer, for efficiency would be conserved in various ways by the combination of the two offices. This matter is further considered in the report of the Executive Committee.

Respectfully submitted,

Edward L. Rice, *Secretary.*

Report of the Treasurer for the Year 1921-1922.

The report of the Treasurer was received as follows and referred to the Auditing Committee whose report is appended.

Balance in Hayden-Clinton Bank March 17, 1920, as previously reported..	$515.74
Received from C. W. Reeder, Librarian, for 1920–1921 sales of publications	12.95
Received from members for dues to A. A. A. S. and the Ohio Academy..	1,174.10
Total	$1,702.79
Less checks	1,085.27
Balance in Bank April 12, 1921	$617.52

The Disbursements have been as follows:

To E. L. Rice for Secretarial expenses	$ 37.81
To L. H. Tiffany for expenses of Business Manager	5.00
To Eunice Evans for assistance for the Treasurer	7.75
To Postmaster, Columbus, for letter-head envelopes	19.46
To Independent Print Shop	30.75
To Spahr & Glenn	101.00
To B. E. Livingston for dues for members of the A. A. A. S.	633.50
To L. H. Tiffany for the Ohio Journal of Science	250.00
Total	$1,085.27

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Balance carried forward	$ 515.74
Cash deposited	1,187.05
	$1,702.79

Dr.

As itemized expenditures	$1,085.27
Balance in hand	617.52

There has been received from C. W. Reeder $37.00 for 1921-1922 sale of publications of the Ohio Academy of Science, which is not included in the account as given.

Below is the statement of the Manager of Ohio Journal of Science, Mr. L. H. Tiffany, which your Treasurer desires to have included in this report, feeling that the members of the Academy are entitled to know the present financial status of the Journal.

Financial Statement of Ohio Journal of Science.
(Volume XXI, 1920–21. The Ohio Journal of Science.)

Receipts—		
Balance from J. S. Hine, 1920–21	$ 19.15	
Separates from Vol. XXI	286.91	
Extra copies of "Journal"	9.10	
Subscriptions to Vol. XXI	16.00	
Ohio State Univ. Annual Allowance	500.00	
Total Receipts		$831.16
Expenditures:		
Bucher Engr. Co., plates, half-tones, etc.	$127.50	
Spahr & Glenn, printing	500.00	
Postage and express	60.82	
Envelopes, bill heads, etc.	7.90	
Total expenditures		$696.22
Balance on hand, 1920–21		$134.94

Cost of printing "Journal"	$830.25	
Cost of printing separates	252.00	
Total printing cost		$1,082.25
Total cost of printing	$1,082.25	
Paid on account	500.00	
Unpaid		$582.25
Balance on hand		134.94
Deficit for 1920–21		$447.31

The deficit indicated for 1920-1921 for the Ohio Journal of Science has been partially relieved by the payment of $250. This is the amount derived from the dollar of the individual membership fee toward the upkeep of the Journal, as provided for in the Constitution of the Ohio Academy of Science. It should be noted that this is the amount derived from membership dues for 1921-1922 and advanced to the Business Manager, in order that he might pay current expenses. As more dues are paid, more money will be advanced, but your Treasurer is not empowered to advance more than the amount allowed by the Constitution. He feels that definite measures should be provided for permanently relieving the embarrassment of the Ohio Journal of Science, which has been and is well managed and has only fallen into debt because of the rising costs of publication. The Journal has a large and growing circulation and is a medium for the communication of papers of the members of the Academy within the State and abroad. It offers rather prompt publication, a desideratum well worth considering in these days of over-crowded journals, many of which face a more serious deficit than our own.

There are two proposals which the Treasurer desires to offer as a means of removing the deficit of the Journal. They are both temporary relief measures. The first is that money be advanced from the Research Fund. This is the more attractive proposal, because the product of scientific research must sooner or later be communicated to some scientific audience. The research fund is open to members of the Academy who desire aid for the completion of their studies. It would be of aid to the worker and his audience alike, if the fund should be drawn upon to remove the deficit of the Journal.

The second proposal is that the Treasurer be empowered to remove the deficit. This has the objection that the measure amounts to the equivalent of increasing, to the subscriber, the cost of the Journal, even though this increase be a temporary one. It is to be distinctly understood that the Treasurer is opposed to any permanent increase in the cost of the Journal. The Editor, Dr. F. H. Krecker, has the problem of keeping up the standard of the Journal at the least cost, and has not indicated that the price of the Journal to subscribers is too low. The two proposals are placed before the Academy with the request that action be taken.

In the meantime an active campaign for more funds should be carried on. An increase in the number of members is greatly desired. An

appeal for individual help for the Journal from persons interested in its welfare and for an increased subsidy from the Ohio State University have both been suggested. No definite action has been taken on these suggestions as yet.

A. E. Waller, *Treasurer.*

The financial portion of the above report has been examined and found correct.

M. E. Stickney,
F. L. Landacre,
Auditing Committee.

Report of the Executive Committee.

The report of the Executive Committee was received as follows and ordered filed.

April 14, 1922.

To the Ohio Academy of Science:

The Executive Committee has met twice since the last Annual Meeting of the Academy. At the first meeting, December 17, Messrs. R. C. Osburn, Waller, Alexander and Rice were present, with Professor Herbert Osborn as guest; at the second meeting, last evening, all members of the Committee were in attendance. Several matters of business have also been handled through correspondence.

That the date of the Annual Meeting was set for April 14 and 15, in Columbus, is already sufficiently well known.

Dean George F. Arps was appointed Vice-President for Psychology, to succeed Professor Rudolph Pintner, resigned.

Twenty-nine applications for membership have been approved during the year, subject to ratification by the present meeting.

A communication was received from Arthur MacDonald, under date of October 11, 1921, urging the adoption of a resolution calling upon Congress to concentrate "the scientific bureaus of the Government under the jurisdiction of the Board of Regents of the Smithsonian Institution, with the view to developing Government science to the highest possible efficiency, by affording scientific workers permanent tenure of office, greater freedom in investigation, non-interference of politics, and adequate salaries." Your Committee deemed it unwise to commit the Academy to this policy.

The Committee recommends that the Academy take action urging upon the colleges of Ohio the desirability of a uniform spring vacation, to facilitate for instructors the attendance upon the meetings of the Academy and other professional societies composed wholly or in considerable part of college men.

The Committee recommends the amendment of Chapter 1, Section 1, of the By-laws by the addition of the clause: "members who have paid regular dues in the Academy for twenty-five years shall also be classed as life members, and shall be relieved of further financial obligations."

The Executive Committee has considered the desirability of modifications of the status of the secretary and treasurer of the Academy in line with the suggestions of the Secretary's report. Such readjustments may make desirable the combination of the two offices and the addition to the Executive Committee of a third elective member. In order that such action may be possible at the next annual meeting, in case it is deemed desirable, the Committee desires that this report be considered as notification of proposed amendment of the constitution. The Committee further recommends the reference of the entire matter to the incoming Executive Committee for further consideration and report.

Respectfully submitted,

EDWARD L. RICE, *Secretary*,
For the Committee.

Report of the Publication Committee.

The following report of the Publication Committee was received and ordered filed.

The Annual Report of the Thirty-first Meeting, Proceedings, Vol. VII, Part 6, contained 54 pages, including the President's address, which also appeared in the November, 1921, number of the Ohio Journal of Science.

It is recommended that beginning with this year the President's address shall be published in the Ohio Journal of Science as soon after the Annual Meeting as possible, that it shall not be offered for publication elsewhere until it has appeared in the Journal and that it shall not be published in the Annual Report.

It is further recommended that the Secretary's report shall be published in the Ohio Journal of Science in the summer or autumn, so that the Annual Report can be printed in December.

It seems desirable also to publish any special address, delivered on invitation before the Academy, in the Ohio Journal of Science.

Since the membership of the Academy is increasing rapidly it is the intention of the publication committee to print 750 copies of the Annual Report and of any special papers, instead of 500 as heretofore.

Respectfully submitted,

JOHN H. SCHAFFNER, *Chairman.*

Report of the Library Committee.

The following report of the Library Committee was received and ordered filed.

April 14, 1922.

To the Ohio Academy of Science:

The Library Committee begs leave to submit the following report:

1. The annual report of the Thirty-first meeting of the Academy, held in 1921, was published in the Ohio Journal of Science for November,

1921, and later reissued with additions as part six of volume seven of the Proceedings of the Academy. Copies of this number were mailed to every person on the membership list, and to the seventy-one scientific societies on the exchange list.

2. The sale of publications during the year has been above the average, the amount received being $37.00. This sum has been turned over to the treasurer.

3. Since the members of the Academy are interested in the development of library resources in the natural sciences, the Committee wishes to take this opportunity to call attention to several very notable additions to the collections of the Ohio State University Library made during the year:

(a) Academie des Sciences (Paris) Memoires, 1666-1770.

(b) Academie Imperiale des sciences de Saint Petersbourg Memoires et bulletin. Complete to date.

(c) K. Akademie der Wissenschaften (Vienna) Denkschriften philosophisch-historische Klasse, v. 1-62, 1850-1918.
Sitzungsberichte philosophisch-historische Klasse, v. 1-180, 1847-48—1915-16.
The Library already owns the Denkschriften and Sitzunberichte of the Mathematisch-naturwissenschaftliche Klasse.

(d) Annales des sciences naturelles, zoologie et botanique, 1824-1908 in 316 volumes. (This is one of the three complete sets in the United States).

(e) Biologia Centrali—Americana; or, Contributions to the knowledge of the fauna and flora of Mexico and Central America; ed. by F. D. Godman and Osbert Salvin, 63 v. 1879-1915.

(f) Journal of Botany, British and foreign, v. 1-46, 1863-1908.

(g) Linnean Society of London, Transactions, 1791-1916, 55 vols.

(h) Societe d'anthropologie de Paris, Bulletin, 57 vols. 1860-1915.

(i) Zoological Society of London. Transactions, v. 1-20, 1833-1915.

Needless to say, all members of the Academy are welcome, not only to the use of these new sets, but also to all the sources in the scientific field which are owned by the University Library.

Very respectfully,

C. W. Reeder,
For the Committee.

Report of the Trustees of the Research Fund.

The following report of the Trustees of the Research Fund was received and ordered filed. The financial portion of the report was referred to the Auditing Committee, whose report is appended.

To the Ohio Academy of Science:

The Trustees of the Research Fund of the Academy submit the following report for the period from March 1st, 1921, to March 28th, 1922.

RECEIPTS.

Cash on hand March 1, 1921, as per last report	$870.90	
Check from Mr. McMillin	250.00	
Interest on Liberty Bonds	25.50	
		$1,146.40

EXPENDITURES.

Paid on grants:		
Nov. 30, 1921, Paul B. Sears	$ 6.20	
Feb. 14, 1922, James S. Hine	50.00	
		$56.20

ASSETS.

Cash on hand March 28, 1922	$1,090.20	
Liberty Bonds at par	600.00	
		$1,690.20

LIABILITIES.

Grants: Paul B. Sears	$ 46.36	
L. B. Walton	100.00	
W. H. Bucher	25.00	
		$171.36
Excess of cash assets over liabilities		$918.84

Two or three recent applications for grants are under consideration.

Vouchers and receipts for the verification of this report are submitted herewith.

Respectfully,

T. C. MENDENHALL,
HERBERT OSBORN,
GEORGE D. HUBBARD,
Trustees.

Examined and found correct.

M. E. STICKNEY,
F. L. LANDACRE,
Auditing Committee.

Report of the Committee on Legislation.

The Committee on Legislation reported that no further action had been taken since the last annual meeting, but recommended that the committee be continued with a view to presenting desired legislation to the next General Assembly.

Report of the Committee on State Parks and Conservation.

In an oral report of progress, the chairman of the Committee, Professor Herbert Osborn, mentioned the great advance that has been made in the acquisition of protected tracts by the Division of Fish and Game of the State Department of Agriculture and by the State Forester, and emphasized the cordial attitude of these officers toward the permanent preservation of the native fauna and flora of these tracts. He also called attention to the very valuable list of Ohio areas desirable for preservation compiled by Dr. E. Lucy Braun, representing the Ecological Society of America, and urged the co-operation of the Academy membership in the extension of this list by the report of additional interesting localities.

Director Taber, of the State Department of Agriculture, was invited by the committee to address the Academy, and spoke very interestingly of the present condition of the tracts owned and leased by the State as game preserves and the plans of the Department for their development and control. He expressed a keen interest in the preservation of all forms of native plant and animal life in these tracts and the desire that the Academy assist, through its Committee on State Parks and Conservation and its individual membership, by the suggestion of desirable tracts and control measures.

On his own request, Professor M. M. Metcalf was excused from the committee, and Professor E. R. Hayhurst elected in his place. The committee now consists of Herbert Osborn, chairman, J. E. Carman, E. R. Hayhurst, F. H. Herrick, C. G. Shatzer, E. N. Transeau.

The following recommendations of the committee were approved by the Academy:

1. That the Committee on State Parks and Conservation be made a standing committee, and that the details concerning time of service and future elections be referred to the Executive Committee.

2. That the Academy favors the establishment of a State Commission on Parks and Conservation, composed of one representative each for the Division of Fish and Game of the State Department of Agriculture, the Division of Forestry of the Ohio Experiment Station, the State Board of Public Works, the State Archeological Society, the State Geological Survey, and the State Board of Health, and two representatives for the Ohio Academy of Science—one a botanist and one a zoologist.

3. That the duties of this commission shall include the following: To advise and co-operate in the selection of tracts desirable for state parks, forests, game refuges, and scientific reservations; to formulate regulations as to the manner in which such tracts may be used for recreational, historic, refuge, scenic, scientific, or other purposes; and to inaugurate measures for the most efficient development of the various tracts for the purposes agreed upon.

The Academy further voted to suggest that the committee consider the advisability of employing a salaried officer to promote conservation work in Ohio.

Election of Officers.

The following officers and committee members for 1922-23 were elected by the ballot of the Academy.

President—Professor A. P. Weiss, Ohio State University, Columbus.
Vice-Presidents:
Zoology—Professor C. G. Rogers, Oberlin College, Oberlin.
Botany—Dr. E. Lucy Braun, University of Cincinnati, Cincinnati.
Geology—Professor K. F. Mather, Denison University, Granville.
Physics—Professor R. C. Gowdy, University of Cincinnati, Cincinnati. (Professor Gowdy declined the vice-presidency, and Professor Alpheus W. Smith, Ohio State University, was appointed by the Executive Committee to fill the vacancy).
Medical Sciences—Professor C. F. Spohr, Ohio State University, Columbus.
Psychology—Dr. H. H. Goddard, Ohio Bureau of Juvenile Research, Columbus.
Secretary—Professor E. L. Rice, Ohio Wesleyan University, Delaware.
Treasurer—Dr. A. E. Waller, Ohio State University, Columbus.
Elective Members of Executive Committee—Professor R. C. Osburn, Ohio State University, Columbus; Professor Lynds Jones, Oberlin College, Oberlin.
Member of Publication Committee—Professor H. C. Sampson, Ohio State University, Columbus.
Trustee of Research Fund—Professor G. D. Hubbard, Oberlin College, Oberlin.
Member of Library Committee—Mr. C. W. Reeder, Ohio State University, Columbus.
Representatives on Editorial Board of Ohio Journal of Science:
Zoology—Professor R. A. Budington, Oberlin College, Oberlin.
Botany—Professor Bruce Fink, Miami University, Oxford.
Geology—Professor G. D. Hubbard, Oberlin College, Oberlin.
Physics—Professor S. J. M. Allen, University of Cincinnati, Cincinnati.
Medical Sciences—Professor F. C. Waite, Western Reserve University, Cleveland.
Psychology—Professor H. A. Aikins, Western Reserve University, Cleveland.

Election of Members.

The Membership Committee reported seventeen names for election to membership; twenty-nine additional names, previously approved by the Executive Committee and marked with (*) in the following list, were presented for ratification. All were elected, as follows:

*Allen, William Ray; Zoology, Ecology, Municipal University of Akron, Akron.
*Auten, Mary; Zoology, Entomology, Botany; Botany and Zoology Bldg., Ohio State University, Columbus.
*Axel, Robert; Psychology; 980 Clinton St., Bronx, New York, N. Y.
*Baringer, John W.; Plant Pathology, Botany; Dept. of Botany, Ohio State University, Columbus.
Bulger, J. W.; Entomology, Plant Pathology, Zoology; Dept. of Zoology and Entomology, Ohio State University, Columbus.
*Conrey, G. W.; Geology; Soils Dept., Ohio State University, Columbus.
Elwood, P. H.; Landscape Architecture; Ohio State University, Columbus.
*Esper, Erwin A.; Psychology; Ohio State University, Columbus.
*Farnsworth, Paul R.; Psychology; 128 W. Tenth Ave., Columbus.
*Gordon, Robert B.; Botany, Ornithology; 478 W. Seventh Ave., Columbus.
Gossard, H. A.; Entomology, Zoology; Wooster.
*Halsted, Frances J.; Psychology, Physiology; 1 Thirteenth Ave., Columbus.
*Hartman, Grace L.; Botany, Physiology; 1868 Rosalind Ave., East Cleveland.
*Hatch, Elizabeth M.; Psychology; 9 Twelfth Ave., Columbus.
Hoskins, R. G.; Physiology; 710 N. Park St., Columbus.
*Humphrey, Sylvester S.; Botany, Plant Pathology; Dept. of Botany, Ohio State University, Columbus.
*Israel, Harold; Psychology; 22 Fifteenth Ave., Columbus.
*Kleckner, M. E.; Chemistry; Heidelberg University, Tiffin.
*Koch, Berthe Couch; Psychology; 303 Whittier St., Columbus.
Lee, M. O.; Zoology; Dorset.
McCormick, Robert N.; Zoology; 161 W. Tenth Ave., Columbus.
*McGlenchay, Chloie D.; Psychology; 52 Pacemont Road, Columbus.
*Madison, Harold L.; Botany, Zoology; 2289 Grandview Ave., Cleveland Heights.
*Manley, R. M.; Physics, Chemistry, Structure of Universe; 738 Schofield Bldg., Cleveland.
Marquart, J. Roger; Zoology, Botany; 900 N. Limestone St., Springfield.
Myer, Bernard S.; Botany; Dept. of Botany, Ohio State University, Columbus.

Neiswander, Claud R.; Zoology; Rawson.
*Parrot, G. H.; Biology, Geology, Physics; 41 E. Eighth Ave. Columbus.
*Peters, Harold S.; Ornithology, Botany; 150 W. Fourth Ave., Columbus.
*Polkowski, Anna; Psychology; 52 Pacemont Road, Columbus.
*Pressey, Mrs. Luella W.; Psychology; Apt. 18, Indianola Courts, 1778 N. High St., Columbus.
*Pressey, Sidney L.; Psychology, Psychiatry; Dept. of Psychology, Ohio State University, Columbus.
Raup, Hugh M.; Zoology, Botany; 1845 N. Fountain Blvd., Springfield.
Runnells, Harmon A.; Botany; Botany Dept., Ohio State University, Columbus.
Secrest, Edmund; Forestry; Ohio Experiment Station, Wooster.
Setterfield, Hugh; Zoology, Botany; Myers Hall, Springfield.
Sisson, Septimus; Veterinary Medicine, Anatomy; Ohio State University, Columbus.
Smith, Alpheus W.; Physics; Ohio State University, Columbus.
Smith, Alva W.; Physics; Ohio State University, Columbus.
Smith, Russell M.; Chemistry, Botany; 69 Neal Ave., Newark.
*Spencer, Herbert; Entomology, Zoology, Ecology; Botany and Zoology Bldg., Ohio State University, Columbus.
*Stauffer, A. S.; Botany; 220 S. Main St., Ada.
*Stockdale, Paris B.; Geology; Dept. of Geology, Ohio State University, Columbus.
*Van Horn, Frank R.; Geology; Case School of Applied Science, Cleveland.
*Wembridge, Mrs. Eleanor; Psychology; 1681 Fulton Road, Cleveland.
*Wembridge, Harry; Psychology; 1681 Fulton Road, Cleveland.

Report of the Committee on Election of Fellows.

The following report of the Committee on Election of Fellows was accepted and ordered filed.

April 14, 1922.

To the Ohio Academy of Science:

A meeting of the Committee on Election of Fellows was held on the evening of April 13th. Five of the joint committee were present; four were represented by duly authorized proxies; two were absent without representation, although the proxy of one arrived just after the close of the meeting.

Sixteen nominations were received by the committee. In the consideration of these nominations the committee was guided by the principles laid down last year—that members should not be elected to fellowship until one year, at least, after election to membership, and that resident members should not be elected to fellowship who are not showing an active interest in the work of the Academy.

Eleven of the nominees received the necessary nine votes (unanimous for those present at the meeting), and were duly elected to fellowship. The newly elected fellows will receive personal notification, and the list will be published in the Annual Report.

EDWARD L. RICE, *Secretary*,
For the Committee.

The list of members elected to fellowship is as follows:

ANNETTE F. BRAUN
E. E. CLAYTON
W. C. DEVEREAUX
HENRY H. GODDARD
CLARENCE H. KENNEDY
KIRTLEY F. MATHER
SUSAN P. NICHOLS
BRADLEY M. PATTEN
JASPER D. SAYRE
ALPHEUS W. SMITH
FRANK R. VAN HORN

Report of the Committee on Resolutions.

The following message and resolutions were presented by the Committee on Resolutions and adopted by the Academy. The message was transmitted to Mr. McMillin in a night letter, and reached him on his seventy-eighth birthday, April 16, the day after the Academy meeting. Mr. McMillin's reply follows the telegram.

(1) Message to Mr. Emerson McMillin, Darlington, N. J.

The Ohio Academy of Science in its thirty-second annual meeting in Columbus desires to extend to you on the occasion of your seventy-eighth birthday its heartiest congratulations, and wishes to express to you its appreciation of your continued support of scientific research through the Academy.

REPLY OF MR. MCMILLIN.

DARLINGTON, MAHWAH, NEW JERSEY, April 18, 1922.

DEAR MR. SECRETARY:

Your telegram conveying the Birthday Greetings of the Ohio Academy of Science was received on time, and was the best tonic I have received during the last fifteen months of almost continuous illness. I do thank you and the Academy most sincerely.

EMERSON MCMILLIN.

EDWARD L. RICE, *Secretary.*

(2) The Ohio Academy of Science wishes to express to the Local Committee and to the authorities of Ohio State University its appreciation for the hospitality extended to the Academy on the occasion of its thirty-second annual meeting.

(3) The Academy wishes to thank Dr. L. R. Jones for his interesting and instructive address on "Disease and Disease Resistance in Plants" delivered before the Academy.

(4) To Dr. Dayton C. Miller the Academy wishes to express its thanks for his stimulating address on "Ether-Drift Experiments at Mount Wilson, California."

S. I. KORNHAUSER,
S. R. WILLIAMS,
For the Committee.

Report of the Committee on Necrology.

The following report of the Committee on Necrology was adopted by the Academy and ordered filed.

BIOGRAPHICAL SKETCH OF GEORGE FREDERICK WRIGHT

By George D. Hubbard,*
Oberlin, Ohio.

In the passing of Professor George Frederick Wright a long life of active, productive work has closed and there goes from our midst one who has been an example and an inspiration to us all. Dr. Wright was born in Whitehall, New York, January 22nd, 1838. His death occurred on April 20th, 1921, of heart failure following influenza. He came of sturdy New England Puritan stock. On his mother's side, the family had been on American soil since 1640; on the father's side perhaps equally long. Mr. Wright's father was a farmer, and this son, one of a large family, acquired his early education in the local schools. At the age of seventeen he had gone as far as the district school could take him, and went out to teach a term in the only kind of school he knew.

It was in 1855, while still only seventeen, that he made the long journey from the old family home at Whitehall to the little college of Oberlin. Four years were spent in the undergraduate course and three in the theological seminary. These seven years came at a time in the history of Oberlin, as well as of the nation, when the social and even the political order trembled, and great questions were before the people. Mr. Wright found Oberlin a splendid place in which to feel his way in the discussion and solution of theologic, scientific, social and political questions, and he always took an intelligent part in such activities. These seven years not only gave him his college and seminary course, but laid the foundations for his future career. They brought out many of the qualities that were subsequently to give him the place he took in the world.

His first public service was a ten-year pastorate of the Congregational Church at Bakersfield, near St. Albans, in northwestern Vermont. His next residence was nearly an equal period at Andover, Massachusetts, as pastor of the Free Church, a residence which threw him in close contact with the stimulating faculty of Andover Theological Seminray. The friendships and intercourse of this period proved of very great value in Mr. Wright's life work. Not only did he meet the men of the Andover faculty, but he came in close contact with scholars of Boston, New Haven, and New York, to whose influence he readily responded. From Andover he was called to Oberlin in 1881 to become

*The author is quite unfamiliar personally with all of Professor Wright's experience save the last fifteen years, but is very happy to have known him so well in these later years. Owing to this lack of first hand information, extensive and frequent use has been made of life sketches prepared for other purposes, even to the borrowing of phrases and sentences. Credit and thanks are hereby given for all.

professor of New Testament Language and Literature in the theological seminary. Eleven years later, through the interest and generosity of a friend who established a chair for the purpose, Prof. Wright was made head of the department of The Harmony of Science and Revelation. In 1907 he reached the retiring age and became Emeritus Professor in the same chair until his death. Thus he had twenty years of pastoral work, twenty-six years of seminary teaching and fourteen years as Emeritus Professor.

When Mr. Wright began his first pastorate he set apart his mornings for scientific study, and they were as carefully preserved for that work as any student preserves his best hours to prepare for his class work. Part of his time was given to field work, a considerable portion to translation from Greek and German, work which greatly increased his proficiency in foreign languages. His studies took him through much theological and scientific literature, among which was Darwin's "Origin of Species." He did very little writing for publication until he entered the second pastorate at Andover, but here the papers began to come at frequent intervals. A few dealt with glacial problems, many with theologic and philosophic questions, and even here there began the long series of papers which came from his pen expressing his belief that there was nothing in science to hinder one's faith in God, Jesus and miracles. Although a strong champion of the theory of evolution, he was also a firm believer in evangelical Christianity. He believed in applying pragmatic tests to Christianity as much as to scientific truth, and this, much to the advantage of both. His scientific studies confirmed his religious conviction and theological conclusions. Open to truth from any source, research or revelation, he believed that no truth could be contradictory, since all was God's, whether expressed in His works or word.

While Prof. Wright's scientific training was very meagre, his scientific interest was always to the front. The home of his first pastorate was on a sand plain with esker and kame connections. This was in the days when the glacial theory for the drift had only begun to make its way. Mr. Wright studied his immediate environment until he became certain that it was the work of a sub-glacial stream. His residence at Andover was also on a prominent glacial feature known as Indian Ridge. It had been popularly attributed to the work of the Indians, but Mr. Wright thought differently and in 1873 in the Bulletin of the Essex Institute he published his first geologic paper. It covered only three or four pages, but it interpreted the ridge as wholly of glacial origin and predicted the finding of its continuation for many miles to the north. His paper inspired observers, and within a few months he had several invitations to visit localities in line with Indian Ridge. These he followed up and established the explanation which he had suggested.

These early radical interpretations of the drift and of many of its forms earned the approval of Asa Gray and Clarence King, and this placed Wright's work in the front rank. He collaborated later with J. P. Leslie and with H. C. Lewis, of the Pennsylvania Geologic Survey

and with G. H. Cook, of the New Jersey Geologic Survey. He traced the moraines and ancient ice borders across New Jersey, Pennsylvania, Ohio, Indiana, Illinois, mostly in the eighties, and published in 1890 Bulletin 58 of the U. S. G. S., summarizing his results. In later years he studied glaciers and the products of their work in Alaska, Greenland, the British Isles, Holland, Belgium, and France, and journeyed completely across Siberia and Russia in his quest for glacial phenomena. These researches gave him the basal material upon which he built the superstructure which made him one of the first men of his age in glaciology.

His field studies were not confined to the work of glaciers, for from the earliest to the end, he was intensely interested in the remains of man that he found associated with the drift. This material was sought and found in many places where he studied the drift itself. Nor did such interest and research stop with man and the drift; for he has been an archeologist in all his travels in Italy, Greece, Palestine, in the region east of the Caspian and in his long journey to Siberia, as well as in the classic fields of western Europe. One of his books deals with the ice age in North America; another, the antiquity of man, and a third, man and the glacial period. These two lines of research were inseparably connected.

While his ministry covered but twenty years and his educational work technically but twenty-six, his research work covered his whole life. His educational work began with the district school before he came to college, was continued in several terms of vacation teaching while in college, and was taken up in his own seminary about twenty years after his graduation. Many of those who were in his classes or knew him as a teacher speak of his kindness of heart, breadth of scholarship, and, above all, his keen interest in the students. He was always looking for the best in them, suggesting lines of work for which he thought they were adapted, and was continually rejoicing in the successes of young people whom he knew.

The second professorship at Oberlin which was given to Prof. Wright in the seminary was established by a friend of the institution who stipulated that the holder should teach but half the year and travel the other half. It was this arrangement which opened up to Mr. Wright the opportunity of travel in Europe in 1892, Greenland in 1894, and his round-the-world trip in 1900-1901. In this latter trip, covering nearly 30,000 miles, he sailed from the United States west coast and after spending some time in Japan, visited Vladivostok and Manchuria, Peking and Kalgan, and made the long journey by rail across Siberia to Irkutsk. From here he journeyed southward and westward through Merv and Samarkand, crossing the Caspian to Tiflis and the Caucasus Mountains, and then proceeded to Constantinople, Palestine, Egypt and southern Europe.

On this trip he was royally received in Japan and Russia, and gave a number of lectures in several places. In fact, Prof. Wright has always had the ability to give an entertaining, inspiring and instructive

address. No record of his platform performance has been found, but it is well known that he was always sought for public addresses on all kinds of occasions, both in his home town and far away. Within a few months of his death he spoke to a learned audience for an hour perfectly logically and without notes. He seemed to have the faculty of marshalling in his public addresses a wealth of information, all organized and laid away for any sudden emergency. While not eloquent, he spoke with convincing directness and clearness. His hearers knew he was thoroughly convinced of what he said. He never trifled with an audience, but took them fully into his confidence.

As an author and publisher Mr. Wright achieved more than many men who do nothing else. His published papers number some five hundred and fifty and his volumes sixteen, some of which were translated into foreign languages, and at least one copyrighted in England. His "Ice Age in North America" has been through six editions and is considered a standard work in its field. Other books have been through more than one edition. His "Story of My Life and Work," published in 1916, sums up many of the conclusions in science and theology which he had reached through his years of study and thought. It also gives a fairly complete bibliography of his papers, the first of which is entitled "Ground of Confidence in Inductive Reasoning," and appeared in 1871, when he was thirty-three years old. But four titles more appear in the next four years; then they come faster, and eight or ten, sometimes fifteen a year flow from his facile pen. Not a year passed but saw papers or book reviews added to his voluminous bibliography, and the last paper was prepared during his last sickness, which was on him for some thirty days.

Beside the papers and books which he prepared for the press himself, he was editor and really the life and heart of the magazine "Bibliotheca Sacra" for thirty-eight years, beginning in 1883. In the year 1900, he with two or three other men in Washington founded a second magazine, "Records of the Past," which continued for twelve years, and then after the publication of a very complete index, was merged in another magazine.

In music, too, he had an active interest. A member of the Oberlin Musical Union for almost forty years, he sang in many oratorio concerts. He brought back and put into shape for American use a number of Russian songs, and was one of three active editors for a very excellent church hymnal.

A cursory glance through the list of his papers reveals the marvelous range of his studies—apologetics, religion, theology and philosophy, politics, history, and biography, commerce, geography, travel, and aesthetics, besides his two great fields of glaciology and archeology. Some of his papers were conciliatory, some controversial; a few were critical, most of them constructive.

Professor Wright was fraternal in spirit and delighted in the fellowship and stimulus of co-workers, yet he has never amassed memberships in learned societies. His affiliations were as follows:

Fellow, American Association for the Advancement of Science.
Fellow, Geological Society of America.
Boston Society of Natural History.
Fellow, Essex Institute.
Ohio Archeologic and Historical Society, (Pres., 1908).
Fellow, Ohio Academy of Science, (Pres., 1899).

In later years he has been unable to attend our meetings annually, but his presence was always profitable and stimulating to the Academy.

Prof. Wright was many-talented, and hence many sided in his interests and pursuits. The amount of his work reveals both his unusual capacity for turning it off and his great intellectual ability. He had a mind in rare degree persistently active, versatile and productive, and he succeeded in gaining interesting and notable attention to his writings and lectures in these many fields, because he made real contributions at many points and always had an attractive way of stating his conclusions.

In his writing and public utterance he vigorously defended his conclusions, not from pride or love of controversy, but because he believed in them and because his conscience would not let him do otherwise. Whether in his familiar surroundings or in strange lands far afield, he was alert and resourceful, companionable and appreciative. No one can say that Professor Wright slighted or mistreated him or intentionally misjudged him. He was quiet, unobtrusive, but genial, winsome, and broad-minded. His clear-cut features, gracious dignity, and unfailing courtesy always made him a distinguished figure in whatever group he stood. He was sympathetic and straight-forward, simple and direct as a child in all his dealings with his fellow men, so guileless that he often could be imposed upon. He was honest and conscientious to the last degree himself and was loathe to believe anyone could be otherwise.

He was deeply religious by nature, a believer in reason in religion, and faith in science, and out of this combination came his power to make his greatest contributions to the thought of his generation. Buoyant and hopeful, always looking forward, his life was full of happiness and achievement, and ran strong to the end. He was the same companion, whether in the privacy of his own home or on a difficult field trip or in a formal public gathering. As he will be missed in scientific and theologic circles, so will he be missed at home in the community for which he always thought and worked. Such a man could not fail to be an inspiration and a tower of strength to his fellows who were permitted to know him.

CHARLES BROOKOVER.

By Herbert Osborn and Francis L. Landacre.

(This sketch was not presented at the meeting, but prepared later for publication in the Proceedings.)

In the death of Professor Charles Brookover, which occurred at Louisville, Kentucky, March 17, 1922, the Ohio Academy has lost one of its distinguished members, one who for many years was associated in the scientific and educational work of the state and contributed worthily to the academy.

He was born in Adams County, Ohio, March 11, 1870, and obtained his collegiate education at Ohio University, at Athens, obtaining the degree of B. Ped. and M. S. from that institution. He carried graduate work at Columbia University and University of Chicago, receiving his Ph. D. degree from the latter institution in 1910. He taught in Colorado College, Buchtel College at Akron, Medical Department of University of Arkansas, and in the University of Louisville, Louisville, Kentucky. Especially while at Akron, where he taught from 1901 to 1913, he was active in the scientific work of the state, attended our meetings with great regularity and was particularly active in the entertainment of the Academy at its Akron meeting in 1910. He spent a number of summers at the Lake Laboratory and was one of the most esteemed members of the staff, serving as Acting Director during the summer of 1914. He was a man of high ideals and a most cheerful, helpful disposition, and his death is mourned by a host of intimate friends and scientific associates.

His research work was largely upon neurology of the lower vertebrates; and in this field he was a recognized authority. His papers, while not numerous, were always thorough and conscientiously worked out. Very little if any, of his work will need revision. He was cautious about propounding hypothesis and always preferred to accumulate a mass of carefully verified facts and then leave the ultimate interpretation to some one else. He was not timid in drawing conclusions, but realized fully that the great need, especially in comparative neurology, is a large body of well established facts from which, finally, safe conclusions may be drawn. He was quite willing to contribute less than his colleagues provided that his contributions could be considered safe and as far as possible, final. What he might have done if he had been in robust health is uncertain. With a serious handicap in health, however, his contributions, especially to comparative neurology, are notable and a matter of pride to his friends and colleagues.

Amendment of Constitution.

ART. VI, SECTION 1. *Annual Meeting.* Amended to read: The date and place of the annual meeting shall be fixed by the executive committee, subject to such instructions as shall be determined by the Academy at the preceding annual meeting, and shall be announced by circular at least thirty days before the meeting. The details of the daily session of each meeting shall be arranged by the program committee and announced in the official program immediately before the meeting.

Amendment of By-Laws.

CHAPTER VI, SECTION 4. *Annual Report.* Amended to read: The Annual Report of the Academy, including list of officers, list of members, secretary's report of the annual meeting, and such other matter as the publication committee may determine, shall be printed as a separate issue by the publication committee.

CHAPTER VI, SECTION 7. *Publication of President's Address and Other Addresses.* New section, to read: The President's address shall be published in the Ohio Journal of Science as soon as possible after the annual meeting, and shall not be published in another scientific magazine until it has appeared in the Journal. Other addresses delivered before the Academy on invitation may be published in the Ohio Journal of Science.

Support of Ohio Journal of Science.

A detailed statement of the financial status of the OHIO JOURNAL OF SCIENCE is included in the report of the treasurer. The question of an additional temporary subsidy to the JOURNAL on the part of the Academy, to relieve the present deficiency, was referred to the executive committee with power.

Scientific Sessions.

The complete scientific program of the meeting follows:

PRESIDENTIAL ADDRESS.

Some common misconceptions of evolution.....RAYMOND C. OSBURN

PUBLIC LECTURES.

Disease and disease resistance in plants.....L. R. JONES
Ether-drift experiments at Mount Wilson, California.....DAYTON C. MILLER

PAPERS.

1. Some proposed state parks for Ohio. (15 min.).....J. ERNEST CARMAN
2. Segregation and man. (15 min.).....MAYNARD M. METCALF
3. American biological stains for microscopical preparations. (10 min.), S. I. KORNHAUSER
4. Further studies in the cytology of Anisolabis. (10 min.) (Lantern), S. I. KORNHAUSER
5. Notes on tropical photography. (5 min.).....WILLIAM RAY ALLEN
6. Some unsolved problems in tidal zone ecology. (By title).....Z. P. METCALF
7. Preliminary survey of certain aquatic habitats on the Bass Islands. (20 min.) (Lantern).....F. H. KRECKER
8. Some results from a pure-line isolation culture of Euglena gracilis Klebs. (5 min.).....W. J. KOSTIR
9. A source of material for study of parasites. (5 min.)..MAYNARD M. METCALF
10. Specific names for parasites. (5 min.).....MAYNARD M. METCALF
11. Studies of the biology of freshwater mussels. (15 min.)...WILLIAM RAY ALLEN
12. The relationship of the Syngnathidae. (15 min.).....JAMES E. KINDRED
13. A quarter century of bird migration at Oberlin. (30 min.).....LYNDS JONES
14. A case of unhindered growth of the incisor teeth of the woodchuck. (10 min.) (Lantern).....STEPHEN R. WILLIAMS
15. A cicindelid from Lake Bennett, British Columbia. (10 min.)..LYNDS JONES
16. Factors influencing reproduction in the cucumber beetle (Diabrotica vittata Fabr.) (10 min.).....W. V. BALDUF
17. Distribution and control of two important grape insects. (10 min.) (Lantern).....D. M. DELONG
18. A study of the distribution of the leafhoppers of Presque Isle, Pa. (5 min.) (Lantern).....D. M. DELONG
19. Emergence of a subimago Mayfly. (5 min.).....F. H. KRECKER
20. Some factors which have limited and directed insect evolution. (20 min.), CLARENCE H. KENNEDY
21. Insect parasites and predators in spider's nests. (5 min.).....MARY AUTEN
22. The inter-relation of the Hessian fly (Phytophaga destructor) and one of its parasites. (5 min.).....T. H. PARKS
23. Biological significance of the endocrines. (20 min.).....A. B. PLOWMAN
24. The effect of formaldehyde on the vitamins of milk. (5 min.), A. M. BLEILE and R. J. SEYMOUR
25. Variation in the dandelion and some of its causes. (15 min.).....P. B. SEARS
26. A forest map of the Erie basin. (15 min.).....P. B. SEARS
27. The distribution of flowering plants on the smaller islands of Lake Erie. (10 min.).....MALCOLM E. STICKNEY
28. The sexual nature of vegetative or dichotomous twins of Arisaema. (15 min.).....JOHN H. SCHAFFNER
29. Influence of length of daylight on sex reversal in hemp. (15 min.), JOHN H. SCHAFFNER
30. Some root and stem rots of clover in Ohio. (10 min.). SYLVESTER S. HUMPHREY
31. Mosaic disease of tomato. (10 min.) (Lantern).....RAYMOND A. DOBBINS
32. Energy relations of plants. (15 min.).....E. N. TRANSEAU
33. Ecological distribution of grasses of North America. (15 min.)..E. L. STOVER
34. The algal food of fishes. (15 min.).....L. H. TIFFANY
35. Seedling blights of corn. (15 min.).....WILMER G. STOVER
36. The course of a plant disease. (15 min.).....WILMER G. STOVER
37. Extension work in plant pathology with special reference to the control of corn and potato diseases. (20 min.).....E. E. CLAYTON

38. Barberry eradication in Ohio. (15 min.).....J. W. Baringer
39. A study of variation in Russula. (5 min.).....H. C. Beardslee
40. Geologic control of river navigation in northeastern Bolivia. (10 min.) (Lantern).....Kirtley F. Mather
41. The gorges of the Yangtze Kiang. (20 min.) (Lantern)..George D. Hubbard
42. An inter-glacial gorge at Youngstown, Ohio. (12 min.).....G. F. Lamb
43. New points in the geology of Kelleys Island. (10 min.).....Mildred Fisher
44. Some new data concerning the Bellefontaine outlier. (10 min.), Clarence F. Moses
45. The Pottsville formation of Ohio. (15 min.).....Helen Morningstar
46. The Bainbridge caves. (10 min.).....Robert F. Webb
47. The formation of box canyons in sandstone. (20 min.) (Lantern). J. E. Hyde
48. Mineralization along the dikes of southern Vermont. (15 min.), Harriet G. Bray and Alden E. Emery
49. The Wheeler National Monument. (15 min.) (Lantern).....Robert F. Webb
50. Colloids in geologic problems. (20 min.).....George D. Hubbard
51. Dynamics of the lithosphere. (25 min.)..O. C. Jones and George D. Hubbard
52. Drainage changes north of Lake Superior. (15 min.) (Lantern), Robert F. Webb
53. The Arctic as one of the centers of distribution of early Paleozoic faunas, August Foerste
54. Meanders of Rio Securé and Rio Mamoré, Bolivia. (10 min.) (Lantern), Kirtley F. Mather
55. Iron molding sands of Ohio. (15 min.).....J. A. Bownocker
56. Report on the Edward Orton Memorial Library. (5 min.)...J. A. Bownocker
57. New fish remains from northwestern Ohio. (15 min.)....J. Ernest Carman
58. Some fossils from the Sylvania sandstone. (10 min.)....J. Ernest Carman
59. Type specimens of fossils in the geological museum at Ohio State University. (5 min.).....Helen Morningstar
60. Stylolites: their nature and origin. (15 min.).....Paris B. Stockdale
61. A mounted topographic map of Ohio. (5 min.).....G. W. Conrey
62. Notes on the Cincinnatian.....W. H. Shideler
63. Forecasting the weather in the Ohio Valley. (20 min.), William C. Devereaux
64. The electron theory of metals. (15 min.).....Alpheus W. Smith
65. The effect of a unidirectional field upon alternating current permeability and energy loss in iron. (15 min.).....Alva W. Smith
66. Infra-red absorption bands as a means of determining molecular properties. (15 min.).....Erwin F. Lowry
67. Certain aspects of the problem of the static versus the dynamic atom. (15 min.).....F. C. Blake
68. The study of "illumination" in physics courses. (15 min.)...F. C. Caldwell
69. Some interesting pictures in infra-red.....Yale Roots
70. Duriron—a product of Ohio industry. (35 min.) (Lantern)..James Withrow
71. A case of dual personality. (20 min.).....Henry H. Goddard
72. The field of psychology. (15 min.).....B. H. Bode
73. The theory of differential education as applied to the handicapped pupils in the elementray grades. (15 min.).....J. E. W. Wallin
74. Qualitative clinical tests and psychological theory. (15 min.)..H. B. English
75. Psychic complexes. (15 min.).....A. W. Trettien
76. A comparison of initial and subsequent examinations of the same individual by the same psychological methods. (15 min.)...Mabel R. Fernald

DEMONSTRATIONS.

1. (a) Common mole (Scalopus aquaticus machrinus Refinesque) "embalmed." (b) Internal parasites of same.....F. A. Hanawalt
2. Tracheation of Lestes nymph.....Clarence H. Kennedy
3. A plerocercoid (larval) tapeworm from the liver of the squirrel—externally segmented.....Stephen R. Williams
4. The head of the woodchuck described in Paper 14.....Stephen R. Williams
5. Types of tomato mosaic.....Raymond A. Dobbins
6. Seedling blights of corn.....Wilmer G. Stover
7. Stalactites in glacial sand and recent conglomerates from Canton, Ohio, G. F. Lamb
8. Illumination charts .....F. C. Caldwell

IRON MOLDING SANDS IN OHIO.

J. A. BOWNOCKER
State Geologist

There are two classes of molding sands—those for steel castings and those for iron castings. The essential difference between them is the melting point. Thus steel molding sand must have a fusion point of not less than 1,600° C., whereas that for iron castings need not have a melting point of more than 1,300° C. As silica or quartz is the main constituent of all molding sands and is also the chief fusion resisting ingredient, it follows that sand for steel castings must be higher in silica than those for iron castings.* Analyses of steel molding sands from Ohio show a silica range of from 95.66 to 99.43 per cent, whereas the silica content of iron molding sands from this State varies from 77.65 to 83.49 per cent.

DISTRIBUTION OF IRON MOLDING SANDS IN OHIO.

Iron molding sands in Ohio are widely scattered, but at present there are three important centers and three of secondary interest. The first includes the shore of Lake Erie, Muskingum County, and Perry County. Those of secondary interest occur in Gallia, Hamilton, and Butler counties.

MOLDING SANDS ALONG THE LAKE SHORE.

Molding sands along the south shore of Lake Erie are of the mantle rock variety. In other words, they are disintegrated and not obtained by crushing sandstones. They are widely scattered, small in area, less than 10 feet in thickness, and lie on low knolls. Within the past few years such sands have been worked in Erie and Ashtabula counties.

The deposits which are described in the following paragraphs are representative for the area. They do not, however, include all that have been worked within the past few years, nor does it follow that all of those described herein are being exploited at the present time.

Erie County.—The molding sand industry in Erie County began as early at least as 1868 and it is still the most important

*For discussion of steel molding sands of Ohio see this journal, June, 1921.

source along the lake shore. The deposits, which are scattered over all the county except the northwest part, are by far the most important in the eastern half. The northernmost deposit worked is on the Shenk farm, about one-half mile south of the Soldiers' Home, where it lies on a low ridge about 200 feet wide, and is probably an old lake beach. About 12 inches of soil is removed and 30 inches of molding sand secured. The sand has a buff color, is without stratification, and no pebbles were observed. Incipient fusion occurs at 1,300° C. and complete fusion at 1,424° C. Its specific gravity is 2.64.

On the J. C. Russell farm, south of Avery, is a deposit of molding sand 6 feet thick at the maximum and located on a low knoll. It is covered by about 8 inches of soil and has been worked for nearly 20 years. The sand has a buff color and is without stratification. The surrounding country is slightly hummocky and doubtless carries sand on the knolls, but the area must be small.

At Parkertown, on the Pennsylvania Railroad, about 8 miles south of Sandusky, approximately 8 feet of molding sand is worked. This differs from most other deposits in the county by the presence of pockets of coarse light-gray sand. The molding sand reaches incipient fusion at 1,327° C. and complete fusion at 1,436° C. Its specific gravity is 2.66.

On the H. J. Mason farm, 2½ miles south of Milan, a maximum of 3½ feet of molding sand is secured from a low knoll, which has a width of perhaps 100 yards. The sand has a yellow color and in places is mottled. No stratification was observed, but its texture is said to vary within short distances. The material is loaded on wagons with a ditching machine. Incipient fusion occurs at 1,300° C. and complete fusion at 1,400° C. Its specific gravity is 2.67. A large quantity of molding sand is available on this and adjacent farms.

Molding sand has been obtained in the vicinity of Ceylon for more than 15 years. The material, which lies on low knolls and has a maximum thickness of 6 feet, is without stratification, but contains occasional pockets of clay.

Sand from Erie County is used for small or medium-sized castings, such as sewing machines, automobiles, agricultural implements, and marine engines. Much of the material is used in its natural condition, but some is mixed with other sand.

When the strength of the sand needs to be increased, molasses or some other binder is added. The market extends as far west as Detroit and Chicago, east to Cleveland, and south to Columbus and Hamilton.

Sands from this county are very much alike in their physical and chemical properties (see analysis on this page), and in their distribution. As previously stated, they lie on low knolls or ridges and are always thin, the heaviest deposit not exceeding 8 feet. Further, they are unstratified. Of their origin there seems to be no doubt. They are deposits that were laid down on the bed of glacial Lake Erie and were later worked over by the wind and deposited by that agent where now found.

Interesting to report, when the molding sand is removed, the underlying material forms a good soil and is used for the same crops as was the material which overlay it.

Composition of Molding Sands, South Shore of Lake Erie.

	Silica, SiO_2	Alumina, Al_2O_3	Iron oxide, Fe_2O_3	Titanium oxide, TiO_2	Calcium oxide, CaO	Magnesium oxide, MgO	Ignition loss
Mason farm, 2½ miles south of Milan, Erie County	79.38	7.96	4.75	.43	1.22	1.09	2.03
Mason farm, 2½ miles south of Milan, Erie County	77.65	9.17	4.34	.33	1.14	1.13	2.72
Shenk farm, Soldiers Home, Erie County	83.49	8.86	2.11	.33	1.78	1.12	1.32
Russell farm, Parkertown, Erie County	82.20	9.24	3.60	.33	1.76	1.13	1.50
Gordon farm, Conneaut, Ashtabula County	79.32	10.08	5.36	.70	1.06	1.21	2.48

Ashtabula County.—Molding sand in this county is confined to the northeast corner, extending west beyond Kingsville and east to the State line and in fact to Springfield, Pa. Nearly all of the deposits lie north of the main ridge road, and hence are near the lake. They are patchy and rather small, measured by acres rather than square miles, and lie on low knolls. A description of the more important deposits follows.

On a knoll on the Hayler farm, northwest of Conneaut and about one-fourth mile from the lake, a deposit 3 feet thick occurs. It is covered with 8 inches of soil, which is removed

by hand labor. The sand has a light yellow color, is unstratified and without pebbles. It is hauled in wagons, loaded directly on cars, and shipped to Erie, Pa.

About 3 miles west of Conneaut on the Gordon farm, a relatively large deposit of molding sand is being worked. Beneath 8 inches of soil lies a maximum of 7 feet of sand which varies somewhat in quality. The upper part is lighter in color and the lower part slightly mottled, and appears more clayey. In places there are thin layers of sand without enough clay to form the necessary bond. About one-fourth mile distant is another deposit which has a maximum thickness of 8 feet.

These deposits are transported by a small locomotive to the New York Central tracks, where the sand is milled and shipped. Milling, however, consists simply of mixing the sands in varying proportions and in this way four grades are secured. The sand from this pit is incipiently fused at 1,336° C. and completely fused at 1,436° C. It has a specific gravity of 2.68.

The product has a wide market, as it is shipped to such distant places as Detroit, Chicago, St. Louis, Buffalo, Pittsburgh, and New York.

In its physical and chemical properties, its mode of occurrence, use, and origin, this sand is similar to that in Erie County.

Physical Tests.—Physical tests of molding sand include the transverse and crushing strength, the venting power or permeability to air, the fusion point and the sieve tests. The fusion point has already been given and the sieve tests may be found on page 29. Tests for transverse and crushing strength and venting power were made after the methods of the American Foundrymen's Association.* For transverse strength, blocks of sand one inch square in cross section and four inches between supports were used, whereas for crushing strength the blocks had the same cross section, but the height was 2½ inches. In each case the breaking weight is expressed in pounds. The venting power is the time in minutes necessary to force one gallon of air with a certain pressure through a block of sand one inch thick.

*American Foundrymen's Assoc., Vol. 21, p. 86.

STRENGTH OF LAKE SHORE SANDS IN POUNDS.

	Dry	With 5% Water	With 7½% Water	With 10% Water
Transverse strength:				
Shenk farm, near Soldiers Home	.33	.12	.09	.05
Russell farm, near Parkertown, Erie County	1.10	.01	.02	.00
Mason farm, south of Milan, Erie County	.50	.21	.04	.06
Mason farm, south of Milan, Erie County	2.09	.32	.35	.15
Gordon farm, near Conneaut, Ashtabula County	.38	.10	.05	.01
Crushing strength:				
Shenk farm, near Soldiers Home	8.05	2.08	.76	.82
Russell farm, near Parkertown, Erie County	8.00	.80	.77	.74
Mason farm, south of Milan, Erie County	10.14	3.71	.20	1.81
Mason farm, south of Milan, Erie County	20.00	5.32	5.76	2.80
Gordon farm, near Conneaut, Ashtabula County	2.91	2.76	.77	.69

VENTING POWER OR PERMEABILITY TO AIR OF LAKE SHORE SANDS.

	Dry	With 5% Water	With 7½% Water	With 10% Water
Shenk farm, near Soldiers Home	.42	.67	.72	.48
Russell farm, near Parkertown, Erie County	.17	.45	.30	.43
Mason farm, south of Milan, Erie County	.50	.95	1.92	.55
Mason farm, south of Milan, Erie County	.50	1.05	1.25	.50
Gordon farm, near Conneaut, Ashtabula County	.42	.53	.47	.58

MOLDING SANDS IN MUSKINGUM COUNTY.*

Muskingum County is the most important source of iron molding sands in Ohio and one of the largest sources in the United States. Although the principal deposits are in the vicinity of Zanesville, they extend north to Dresden, east to Sonora, and southeast to Duncan Falls. In altitude the sands present marked variations—from 700 feet above sea level on the flood plain of the Muskingum River to 900 feet on top of the adjacent hills.

*For a detailed account of the molding sands of Muskingum County see Geol. Surv. of Ohio, Bull. 21, Chap. 7.

The largest known deposit of molding sand in the county lies on the northern half of South Zanesville hill at an elevation of 900 feet. No complete section of these deposits was seen but an employee who has worked on the hill for 15 or more years gave the following succession:

Soil	2 ft.
Brown sand, No. 3. No pebbles	8
Brown sand, No. 1. Finer than the above	4
Coarse gray sand, with many sandstone fragments, but no foreign pebbles	15
Coarse, sharp sand without sandstone fragments	8
Shale, reported.	

All this material, except soil at top and shale at base, has been used for molding purposes. The two sands below the soil are similar except for fineness of grain and this doubtless varies horizontally. Surfaces exposed to weathering show stratification, but fresh surfaces do not. These sands are marketed without milling; by mixing them various grades may be secured. Both sands are considered a wind deposit, which is indicated by fineness of grain, absence of pebbles or coarse fragments of rock, lack of foreign material, and by their altitude of 900 feet, or 200 feet above the valley.

The coarse gray sand which occurs next in descending order contains fragments of shaly sandstone with a maximum length of 4 or 5 inches and a thickness that rarely attains one-half inch. They are not evenly distributed, but in places occur in pockets and there may form the larger part of the mass. The fragments very closely resemble the coarse shaly sandstone that is found in the surrounding country, from which it doubtless originated. This material, sand and shaly sandstone, is hauled to the mill where it is crushed, screened, and then marketed as No. 3 sand. It is the only hilltop deposit of this type that has been found in the county; moreover its area is small, about 600 feet north-south and 200 feet east-west. Doubtless it was the work of running water before the present topography was developed, and its source was the sandy shale or thin-bedded sandstone of the surrounding country.

Microscopic examination of this variety was made by Prof. W. J. McCaughey, who listed the following minerals in order of their abundance.

1. Quartz.
2. Orthoclase.
3. Microcline.
4. Muscovite.
5. Biotite.
6. Magnetite.
7. Calcite.
8. Hornblende.
9. Tourmaline.
10. Garnet.

Chemical analysis of this sand gave Prof. D. J. Demorest the following results:

Silica, SiO_2	80.66 per cent
Alumina, Al_2O_3	6.56
Ferric oxide, Fe_2O_3	5.34
Titanic oxide, TiO_2	.60
Lime, CaO	1.00
Moisture at 105° C	1.27
Ignition loss	2.53

At the east end of the South Zanesville hill is a pit where the following section was measured:

Soil	1 ft.
Fine sand, unstratified, mottled, no pebbles	11
Shaley sandstone, rotten	3
Sandstone, rotten	1

The whole section, soil excepted, is worked. The rotten shale and sandstone are distinctly stratified and are without doubt in place, that is, have not been transported from some other location.

Molding sand has been obtained at several other places on the west side of the Muskingum River. Among these may be mentioned the flood plain of this river just below the tube works, at an altitude of 700 feet; top of Putnam Hill at an elevation of 900 feet; near Drake Station, where the sand lies about 820 feet above sea level, is stratified, contains small pebbles, and is therefore considered a water deposit. This material is crushed in a dry pan and then screened. About one mile north of Ellis the sand occurs at an elevation of 850 feet, is without stratification, and free from pebbles. It is fine grained and may be classed as No. 1. Near Dresden are two or three deposits which have been worked in recent years. The material varies in texture from coarse to fine and in places shows stratification. An occasional pebble or rock fragment was found and the sand is therefore considered a water deposit. A sample from the pit of the Central Ohio Sand and Gravel Co., one-half mile south of Dresden, was analyzed by Prof. Demorest, with the following results:

Silica, SiO_2	83.25 per cent
Alumina, Al_2O_3	8.11
Ferric oxide, Fe_2O_3	3.14
Titanic oxide, TiO_2	.30
Lime, CaO	.40
Magnesia, MgO	.54
Ignition loss	4.28

MOLDING SANDS EAST OF THE MUSKINGUM RIVER.

One of the largest deposits of molding sand in Muskingum County lies at an altitude of 900 feet on a hill in the northeastern part of Zanesville. The following section was measured in this pit in 1917:

	Soil and clay	2½ ft.
4.	Fine sand	4
3.	Red sand	4
2.	Coarse sand	2
1.	Fine sand	10
	Clay unmeasured.	

The basal sand is marketed as No. 0 and No. 1; it is used for brass and for small iron castings. Sand 2 of the section is not commonly used alone, but is mixed with 3 and 4 and then makes No. 2 and 3 sands. Sand 3 was not marketed alone when the pit was visited, but was mixed with other sands. Sand 4 was mixed with 2 to form a No. 2 sand.

The silica range of sands from this pit, according to Prof. Demorest, is from 81.76 per cent to 85.99; alumina from 5.24 to 8.26; and iron oxide from 2.94 to 4.20.

Sands similar to those just described have been worked directly across the river from the American Rolling Mill Co. at an altitude of 800 feet.

Near the eastern limit of Zanesville are numerous deposits of molding sand. One of these, opened about 35 years ago, measures approximately 30 feet in thickness. It consists of sand and clay, the latter measuring as much as 10 feet in depth. The sand is distinctly stratified and carries many pebbles, some of which measure 4 inches in diameter. The sand and clay are ground together and then screened. By mixing the materials in varying proportion several varieties of sand are secured.

At the station Oakland is another deposit and, like the preceding one, it lies about 820 feet above sea level. When visited it had a maximum thickness of 15 feet, contained many small pebbles, and was distinctly stratified. Near-by is a ledge of about 12 feet of coarse sandstone, which is ground with the sand. On top of the knoll is a thin bed of brown sand, without pebbles or stratification. By mixing these deposits, as many as 14 varieties of molding sand are reported to have been produced.

Molding sands exist southeast of Zanesville and have been worked near Lawton and Pierce. A smaller deposit occurs a mile north of Duncan Falls.

MOLDING SANDS IN PERRY COUNTY.

The one important center for molding sand in Perry County is in the valley of Rush Creek and the deposits now worked extend from about 1 mile to perhaps 3 miles east of New Lexington.

The materials which form the basis of the industry are sandy loam and rotten sandstone. The sandy loam was formed by the disintegration of sandstone or sandy shale and it gradates into the underlying rotten sandstone. Above the loam is 1 to 2 feet of soil, which is rejected. These materials lie above the No. 6 or Middle Kittanning coal, and hence near the top of the Allegheny formation.

The plant of the New Lexington Sand Co., which lies about one mile east of New Lexington, was opened in 1904 and is the pioneer plant of the district. Following is a section in the pit:

Soil	1 ft.
Sandy loam (binder)	5
Rotten sandstone	12

The rotten sandstone, which is coarse grained, thin bedded, and carries numerous flakes of white mica, contains some iron, and has a yellow color. The company owns 100 acres of good rock, so that its supply of raw material is very large.

The materials from this pit are run through a disintegrator and thus reduced to coarse sand, when it is ready for shipment. Two grades are made by mixing the rotten sandstone and binder in different proportions. In one there are approximately two parts of sandstone to one of binder, whereas in the finer variety these proportions are reversed. This sand softened at 1,345° C. and liquified at 1,436° C. Its specific gravity is 2.64.

An analysis of the finer sand (one part sandstone to two parts of binder) from this plant was made by Prof. D. J. Demorest with the following result:

Silica, SiO_2	82.17 per cent
Alumina, Al_2O_3	8.77
Iron oxide, Fe_2O_3	4.44
Titanium oxide, TiO_2	.55
Calcium oxide, CaO	.50
Magnesium oxide, MgO	.79
Ignition loss	3.07

Prof. Wm. J. McCaughey made a microscopic examination of this sand and reported the following minerals which are listed in order of their abundance:

1. Quartz.
2. Orthoclase.
3. Microcline.
4. Muscovite.
5. Biotite.
6. Tourmaline.
7. Zircon.
8. Magnetite.

Quartz and feldspars are the essential minerals, but hornblende and biotite are important accessories. Other minerals are found only in small proportions.

Just east of the New Lexington sand plant is that of the Superior Sand Co., which works about 20 feet of rock, the upper 3 feet more or less being a sandy loam used as binder and the lower 17 feet a coarse-grained rotten sandstone. The material is loaded on cars by a planer which does the work of 10 men. The base of the pit is about 20 feet above the Middle Kittanning or No. 6 coal.

Approximately one-half mile farther east is the plant of the Lancaster Coal and Sand Co., which works about 18 feet of rotten sandstone covered with 3 feet more or less of loam and soil. The deposit lies about 20 feet above the Middle Kittanning or No. 6 coal. It is worked with a steam shovel and run through a disintegrator. Shipments were first made in 1919.

On the north side of the valley is the plant of the Ayers Mineral Co., which works the rock to a maximum depth of 26 feet, but it is so variable in texture that in places only a few feet is satisfactory. The rock is cut and loaded by a planer and is then run through a disintegrator and shipped.

The plant of the Jones Sand Co., also on the north side of the valley, at Goston, is the easternmost in the field. A section taken in the pit follows:

Soil	8 inches
Sandy loam (binder)	4–5 feet
Rotten sandstone	8–9 feet

This plant is unique in that bond and sand are mined separately; whereas the usual practice is to mine them together so that the proportion of sand and bond is not controlled except in a very crude way. By separate mining the two constituents may be mixed in any desired proportion. Thus one large customer calls for 10 parts of sand to 1 of bond, while another asks for the proportion of 5 to 4.

The materials are loaded on cars with a steam shovel and then hauled to a mill where they are run through a disintegrator. This sand softened at 1,345° C. and liquified at 1,478° C. Its specific gravity was 2.64.

A sample of No. 5 sand from this plant was analyzed by Prof. D. J. Demorest with the following result:

Silica, SiO_2	82.06 per cent
Alumina, Al_2O_3	8.01
Iron oxide, Fe_2O_3	3.70
Titanium oxide, TiO_2	.35
Calcium oxide, CaO	.56
Magnesium oxide, MgO	.96
Ignition loss	2.72

The same grade of sand was examined microscopically by Prof. Wm. J. McCaughey, who reports the following minerals which are listed in the order of their abundance:

1. Quartz.
2. Orthoclase.
3. Muscovite.
4. Microcline.
5. Biotite.
6. Magnetite.
7. Hornblende.
8. Albite.
9. Epidote.

Quartz and orthoclase comprise the mass of the sand. Muscovite is common, but most of the other minerals listed are found only occasionally.

Strength of Perry County Molding Sands in Pounds.

	Dry	With 5% Water	With 7½% Water	With 10% Water
Transverse Strength:				
No. 5 Sand, New Lexington Sand Co..	3.88	.48	.73	.39
No. 5 Sand, Jones Sand Co., Goston...	4.85	.62	.52	.12
Crushing Strength:				
No. 5 Sand, New Lexington Sand Co..	46.65	10.37	10.60	8.21
No. 5 Sand, Jones Sand Co., Goston...	51.00	8.66	7.72	3.36
Venting Power or Permeability.				
No. 5 Sand, New Lexington Sand Co.....	2.30	2.42	2.05	1.67
No. 5 Sand, Jones Sand Co., Goston.....	.50	.95	.55	.37

MOLDING SANDS IN GALLIA COUNTY.

Molding sands are being developed along the Hocking Valley Railway in Gallia County from Mills Station to the vicinity of Bidwell, a distance of about 6 miles.

When visited in September, 1921, the southernmost sand pit was on the Humphrey farm in the northern part of Section 12, Green Township. The deposit is lens shaped with a maximum thickness of 14 feet and is covered with approximately 18 inches of stripping. Its altitude is 660 feet above tide.

The sand has a light brown color. It appears very largely unstratified, especially in the upper part, but near the base distinct layers were observed in one or two places. Stratified sand was reported below the base of the pit and with a thickness of 4 feet, but it is not mined as it is unsuitable for molding purposes. It is said to have various colors, some of it light gray. In texture the sand is finest in its higher parts and distinctly coarser below. Black streaks were noted in places and sandy concretions were found, but these appeared to be of secondary origin. Pebbles were neither seen nor reported. The sand is hauled in trucks to the Hocking Valley Railway, 1½ miles distant, and shipped without milling to Michigan, Indiana, and Illinois, as well as various places in Ohio. It is used for small castings and especially in automobile work.

The largest sand pit in Gallia County is at Kerr, on the Hocking Valley Railway. The pit is about 660 feet above sea level, and 6 acres are estimated to have been worked over. The deposit is lens shaped and it has a maximum thickness of 16 feet.

The color is the usual shade of brown and is similar to that on the Humphrey farm and elsewhere in Gallia County. The material is finest in texture near the top; below it is distinctly sandy in places. When a fresh surface is exposed there is little or no evidence of stratification, but on weathering layers become distinct. Numerous sandstone pebbles were noted, but they can be crushed easily between the fingers and hence probably are of secondary origin.

The sand is loaded on cars with a steam shovel and hauled by gravity to a mill where it is run through a disintegrator. It is then marketed at Detroit, Chicago, and Indianapolis, as well as in numerous Ohio cities. The sand is classed as No. 4 and is reported to be one grade coarser than that from the Humphrey farm. It is too coarse for fine castings and is used for automobile cylinders, blocks, car wheels, machine frames, etc. When working to capacity the plant is reported to produce 250 tons of sand per day.

Origin of Gallia County Moulding Sands

Mr. J. M. Weed, County Surveyor, has plotted on topographic maps the locations of all the molding sand deposits that have been worked in Gallia County and they lie pretty uniformly 660 feet above sea level. A second characteristic is their stratification, though this is not evident in most places unless the bluff has been exposed to weathering. A third factor is the similarity in color, texture, and other physical properties of the several deposits. A fourth point is their location in a preglacial valley whose waters flowed north and hence were dammed or ponded by the great continental ice sheet.

From this evidence it appears that the sands under consideration are of glacial origin, that they were carried from the ice by glacial streams and deposited in the broad valleys which were at that time occupied by long, narrow lakes. When the ice withdrew, the waters of the lakes had found an outlet to the south and the lakes were slowly emptied. Probably at that time these silts covered the valley floor, but most of them were removed by subsequent erosion.

CINCINNATI AND VICINITY.

Molding sand has been shipped from Delhi at the extreme western edge of Cincinnati since about the year 1889. Some of the deposits lie at or near the foot of the river front hills, others on the slopes, and others still on the summits of these hills at an elevation of 800 feet. The deposits are small and patchy, and are reported to be restricted to the river front hills between Muddy Creek and Goose Creek.

The deposits are of two distinct types—one is fine and loam-like and the other contains pebbles. All deposits are lens shaped and the areas are small.

The fine loam-like material has a maximum thickness of about 7 feet. It lacks stratification, has a yellow color when dry and a tendency to stand with steep slopes. In places vertical cracks were noted and these gave the mass the appearance of blocks standing on end. This material is used for fine castings and is marketed as No. 1, No. 2 and No. 3 sands. In a pit on the land of Jacob Fliehman in the Ohio Valley, the No. 1 sand lay at the base and the No. 3 sand at the top, with the No. 2 between. The different grades, however, are much alike in texture as well as in other respects. The sand is not milled.

The coarse pebbly material was noted only on the tops of the river front hills. It has a yellow color when dry, but a darker shade than that of the fine material at the surface. The pebbles are numerous but small, the largest seen not exceeding 3 inches in diameter. Many of them are well rounded and all appeared weathered. The pebbles are of the common types—igneous, sedimentary, and metamorphic. On exposure faint stratification was observed in one place, but this was not where the pebbles were most abundant. The maximum thickness observed of this pebbly material is about 18 feet. It is used at Cincinnati and other places for large castings. A section on top of a hill on land of Jacob W. Fliehman follows:

Fine sand, No. 1	5 ft.
Light-gray sandy clay, rejected	1
Pebbly sand, No. 4	12
More pebbly sand, No. 5	5

The-light gray material between the pebbly sand and the fine material at the top is unsuitable for molding purposes and has to be rejected. It forms a thin layer, not more than one foot in thickness and appears to be persistent. It resembles the "white clays" of southwest Ohio and may be their counterpart.

The origin of these molding sands appears to be clear enough. The fine material has been transported and deposited by the wind, while the pebbly material is of glacial origin. The latter is much the older and was laid down during Illinoian glacial time, long before the glacial deposits in central and northern Ohio. After the pebbly material was deposited the white clays were laid down on them and still later they in turn were buried beneath the fine yellow sands.

About one mile up the Ohio Valley from North Bend and on top of a river-front hill at an altitude of about 740 feet is a deposit of molding sand that has been worked in an irregular way for more than 28 years. The material closely resembles the pebbly variety found at Delhi, but the proportion of pebbles varies greatly and in places they are rare. Occasional pockets of stratified sand were observed in the pebbly material. The maximum thickness of the deposit that has been worked is reported to be 20 feet. The origin of the deposit is similar to that of the pebbly material at Delhi. The pipe works at Addyston, about one mile distant, has been the principal market for this molding sand.

A third source of molding sand in the Cincinnati district is at the village of Cleves, about one mile north of North Bend. The deposit is at an altitude of about 640 feet and hence does not lie at the summit of the upland, which here is about 800 feet above sea level.

The sand exposed in the pits has a maximum thickness of perhaps 30 feet. The top 6 to 8 feet is a loam and below this is a large deposit of coarse, sharp, gray sand that is distinctly stratified. This sand by itself lacks binder and hence does not make a molding sand. Mixed with the loam at the top, however, it has adequate strength and is well suited for castings. These pits were opened about 1917.

The loam at the top is similar to the fine material at Delhi and appears to have had a similar origin. The underlying sharp, gray sand looks very much like a water deposit (it faces the Miami River), but it may have been transported and deposited by the wind.

MOLDING SANDS IN BUTLER COUNTY.

The molding sand of Butler County lies about one and one-half miles northeast of Overpeck, or approximately 6 miles from Hamilton. Following is a section taken in the pit of the Buckeye Molding Sand Co., on the John Letschke farm:

Soil	1 ft.
Molding sand	3
Sharp sand	10–15

The molding sand, which varies in thickness from 2 to 4 feet, has a brown color and is without stratification. Pebbles up to one inch in diameter are common. The material is used in the foundry at Overpeck, and also trucked to Hamilton, where much of it is shipped by rail to Cincinnati, Columbus, Cleveland, and several places in Indiana. The material is not milled. It is used for gray iron castings, which weigh from 100 pounds to 40 tons.

The deposit lies in the angle between Four Mile Creek and the Miami River at an elevation of 640 feet. It is a silt that was deposited by those streams when the territory was a flood plain. The Buckeye Company has a lease on 40 acres and has worked the deposit approximately 10 years. Sand of like quality is now worked on an adjacent farm. Similar material is reported to have been gotten near Four Mile Creek about 30 years ago.

MOLDING SAND SCREEN TESTS.

	Over 10 mesh	Between 10 and 20 mesh	Between 20 and 30 mesh	Between 30 and 40 mesh	Between 40 and 50 mesh	Between 50 and 60 mesh	Between 60 and 80 mesh	Between 80 and 100 mesh	Over 100 mesh	Average Fineness
Sand from Shenk farm near Soldiers Home, Erie County	.13	.20	.22	.29	.39	.51	2.33	.86	95.07	97.72
Sand from Mason farm, 2½ miles south of Milan, Erie County	.15	1.05	2.27	7.62	9.54	10.12	19.51	2.53	47.21	72.66
Sand from Mason farm, 2½ miles south of Milan, Erie County	.07	1.18	3.83	7.82	12.92	10.32	18.21	1.33	44.32	69.87
Sand from Russell farm, Parkertown, Erie County	.00	.12	.23	.36	.97	1.23	4.46	1.28	91.35	96.22
Sand from Gordon farm, Conneaut, Ashtabula County	.35	.69	.82	.57	.61	.67	1.51	.85	93.93	96.50
Ayers Mineral Co. No. 3 Sand, South Zanesville, Muskingum County	1.68	2.61	5.23	39.26	.01	12.05	11.29	.72	27.15	53.61
Central Ohio Sand & Gravel Co. No. 2 Sand, near Dresden, MuskingumCo	.03	.18	1.30	4.57	4.42	4.47	7.58	1.53	75.92	87.34
Zanesville Sand Co. No. 1 Sand, Zanesville, Muskingum County	.00	.02	.11	.09	.26	.12	1.13	.11	98.16	99.14
Zanesville Sand Co. No. 2 Sand, Zanesville, Muskingum County	.00	.01	.04	.51	5.62	11.95	23.62	5.77	52.48	79.65
Zanesville Sand Co. No. 3 Sand, Zanesville, Muskingum County	.00	.02	.11	1.37	5.17	13.37	22.70	5.98	51.28	78.87
New Lexington Sand Co. No. 5 Sand, New Lexington, Perry County	.49	.99	8.52	30.21	20.78	7.23	7.76	.66	23.36	51.34
Jones Bros. Sand Co. No. 5 Sand, Goston, Perry County	.02	2.02	33.25	33.34	12.33	3.84	3.62	.21	11.37	37.42

SURFACE PLANKTON PROTOZOA FROM LAKE ERIE IN THE PUT-IN-BAY REGION.

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INTRODUCTION.

The observations recorded in the present paper were made during the summer of 1920, from July 7th to August 1st, at the Lake Laboratory, maintained at Put-in-Bay, Ohio, by Ohio State University. The writer is indebted to Dr. F. H. Krecker for help in selecting and procuring collecting apparatus and to Dr. R. C. Osburn for helpful encouragement.

DESCRIPTION OF THE COLLECTING STATIONS.

Collections were made (1) from the open lake, (2) from Put-in-Bay, in the vicinity of the United States Bureau of Fisheries buildings, from July 7th until July 22 only, and (3) from Terwilliger's Pond throughout the period of study.

In the open lake, the bottom mud was hard. Larger vegetation was absent. The algæ, *Pediastrum*, *Tabellaria* and *Asterionella* were plentiful. Diatoms also occurred in large numbers.

Where collections were made from Fishery Bay, as the second station will be termed, the water was about eight feet deep. The bottom mud was hard. The same algæ and diatoms were present as in the open lake. During the first part of July, the larger vegetation was lacking, but toward the end of the month, a great quantity of eel grass and a small quantity of *Myriophyllum* were present near the Bureau of Fisheries docks.

Terwilliger's Pond is about 100 yards long by 75 yards wide. The average depth is two feet. The bottom was covered with soft mud. *Myriophyllum* and eel grass were abundant.

The former reached the surface in a number of places during the latter part of July. The shore sloped gradually and there were many floating tree trunks in the water and along its edge. The pond was well lighted throughout the day. It was well protected from the wind because the surrounding land was considerably higher and covered with trees. Even when Fishery Bay and the lake were rough, the surface of Terwilliger's Pond was only slightly disturbed.



FIG. 1—Terwilliger's Pond



FIG. 2—Entrance to Terwilliger's Pond

At one end, Terwilliger's Pond is connected with Fishery Bay by a channel about fifteen feet wide. The current in this channel reversed every eight to fourteen minutes. These intervals were of longer duration when a large boat came into the bay.

Water snakes, turtles and fish were plentiful in the pond.



Fig. 3—Fishery Bay

Table I.

Shows the Transparancy and Temperature Variations of the Three Stations.

	TEMPERATURE	TRANSPARENCY
Open lake	22—24 degrees	3 ft.—3 ft. 6 in.
Fishery Bay	22—25 degrees	2 ft.—3 ft. 6 in.
Terwilliger's	20—28 degrees	9 in.—17 in.

PLANKTON.

The Protozoa found in the plankton may be separated into two groups; namely, (a) those forms which are large enough to be captured readily with a regular plankton net whose straining surface is made of bolting cloth, and (b) those forms which are so small that they readily pass through the meshes of this bolting cloth. The former constitutes the net plankton and the latter is called the nannoplankton.

Net Plankton Methods.

Identifications were made from the living material only. Twenty-four gallons (approximately one cubic meter) of water from the upper foot, were poured through a silk plankton net and the Protozoa in this amount of tow were counted as follows: one drop of tow was found to be equal to one-tenth of a cubic centimeter. The Protozoa were enumerated by placing a drop (one tenth cubic centimeter) of tow on a slide and, by means of a mechanical stage and compound microscope, the organisms present were counted. This number multiplied by ten gave the equal of one cubic centimeter and this number multiplied by the number of cubic centimeters of tow gave the approximate number of organisms per cubic meter of water.

Nannoplankton Methods.

To determine the number of nannoplankton Protozoa, one-half gallon of the water which had passed through the plankton net, was filtered through hard surface filter paper. The filtered organisms were carefully washed from the paper, the volume of the wash water containing the organisms was taken, and the samples of it were then used for enumeration. Even with the best quality of hard surface filter paper, many individuals must have become embedded in the meshes so firmly that they could not be washed out. The method of counting was the same as that used for the net plankton.

The filter method was a very slow one. Two hours were required to filter one-half gallon of water.

List of Surface Plankton Protozoa.

The forms observed during the brief period of study numbered 66. The greatest number, 59, was listed from Terwilliger's Pond; 23 forms came from Fishery Bay and 18 forms from the open lake.

The Protozoa were distributed as follows among the groups: 27 flagellates, 25 ciliates and 14 rhizopods.

Juday (1921) called attention to the fact that the quantity of plankton is not so large per unit of surface in the shallower water as it is in the deeper water, but the larger bottom population in the former region tends to counterbalance the deficiency when the question of the total production is consid-

ered. The writer did not find this to be so in the case of surface plankton Protozoa. The number of forms from the surface of the shallow pond, Terwilliger's, outnumbered those in Fishery Bay by 36 and those in the open lake by 41. One exception may be cited. The rhizopod, *Difflugia lobostoma* Ehr., was more numerous in surface plankton catches from the open lake and Fishery Bay than it was in the pond.

Rhizopoda.

Actinophrys sol.
Ameboid forms.
Arcella vulgaris.
Centropyxis aculeata.
Cyphoderia ampulla.
Difflugia acuminata.
Difflugia corona.
Difflugia lobostoma.
Difflugia lucida.
Difflugia pyriformis.
Euglypha ciliata.
Heterophrys (?).
Heterophrys myriapoda.
Raphidiophrys viridis.

Mastigophora.

Anthophysa vegetans.
Ceratium longicorne.
Cryptomonas ovata.
Dinobryon sertularia.
Distigma proteus.
Eudorina elegans.
Euglena spp.
Euglena (sp?).
Euglena acus.
Euglena deses.
Euglena spirogyra.
Euglena viridis.
Gonium pectorale.
Pandorina morum.
Peranema trichophora.
Peridinium (sp?).
Peridinium tabulatum.
Phacus longicaudus.
Phacus pyrum.
Phacus triqueter.
Platydorina caudata.
Trachelomonas acuminata.
Trachelomonas armata.
Trachelomonas caudata.
Trachelomonas hispida.
Trachelomonas volvocina.
Volvox aureus.

Ciliata.

Amphileptus anser.
Aspidisca costata.
Blepharisma musculus.
Cinetochilum margaritaceum.
Codonellacratera.
Coleps hirtus.
Colpoda (sp?).
Cyclidium glaucoma.
Dileptus gigus.
Frontonia (sp?).
Frontonia acuminata.
Glaucoma scintilans.
Halteria grandinella.
Holophyra lieberkuhnii.
Loxodes rostrum.
Oxytricha (sp?).
Pleurotricha grandis.
Prorodon armatus.
Rhabdostyla sphaeroides.
Stentor caeruleus.
Trachelius ovum.
Uroleptus piscis.
Vorticella (sp?).
Vorticella brevistyla.
Vorticella microscopica.

RHIZOPODA.

1. *Actinophrys sol* Ehr. Terwilliger's pond. This pond was plentiful in only two tows, one made at night and the other at 9 o'clock in the morning.

2. Ameboid forms were abundant in the open lake and Fishery Bay between July 8 and 16. During the entire month, they occurred spasmodically in very large numbers in the pond. The largest numbers were present in the filter paper catches.

3. *Arcella vulgaris* Ehr. An occasional individual was seen in water from the open lake and Fishery Bay. Small numbers were taken in Terwilliger's pond throughout the latter part of July.

4. *Centropyxis aculeata* Stein. Only a very few were taken at different times at each of the three collecting stations.

5. *Cyphoderia ampulla* Leidy. One individual was identified from Fishery Bay.

6. *Difflugia acuminata* Ehr. One occurred occasionally in Fishery Bay and Terwilliger's Pond.

7. *Difflugia corona* Wallich. This form occurred in small numbers in one collection from the open lake and at almost the same time in one catch in Fishery Bay. It occurred regularly in small numbers in Terwilliger's Pond throughout the period of study.

8. *Difflugia lobostoma* Ehr. Occurred regularly throughout the period of study in considerable numbers from all three stations. The numbers of this species taken from Terwilliger's Pond were somewhat greater than from the other two stations. The most individuals occurred in filter paper catches. Many were seen to conjugate. One of the individuals extruded protoplasm, a large mass of it containing much water. The protoplasm after remaining relatively motionless for a time, became active.

9. *Difflugia lucida* Penard. Plentiful in two tows made in succession at six o'clock in the afternoon and at four o'clock in the morning. Most of them were found in the filter paper catch.

10. *Difflugia pyriformis* Perty. A very few were taken in one tow from Terwilliger's Pond.

11. *Euglypha ciliata* Ehr. Two individuals were recorded from Terwilliger's Pond.

12. *Heterophrys* (?). Numerous in one net tow from Fishery Bay.

13. *Heterophyrys myriapoda* Archer. One was taken in a collection made under the bridge connecting Terwilliger's Pond with Fishery Bay.

14. *Raphididiophrys viridis* Archer. One taken in Fishery Bay.

MASTIGOPHORA.

15. *Anthophysa vegetans* Muller. Numerous in filter paper catches from Terwilliger's Pond.

16. *Ceratium longicorne* Perty. A considerable number in one tow from the open lake. A few individuals in each of three collections from Fishery Bay. An occasional one from Terwilliger's Pond.

17. *Cryptomonas ovata* Ehr. Numerous in one filter paper catch from Terwilliger's Pond. A few others in another catch from the same station.

18. *Dinobryon sertularia* Ehr. A very few in one tow from the open lake. Somewhat more numerous in scattered collections from Terwilliger's Pond.

19. *Distigma proteus* Ehr. One from Terwilliger's Pond.

Eudorina elegans Ehr. Common in all collections from Fishery Bay and the open lake. Abundant at all times from Terwilliger's Pond, but increasing in numbers greatly toward the latter part of July. The greatest number occurred in filter paper catches.

Euglena spp. A few in one tow from Fishery Bay. Very abundant throughout the period of study in Terwilliger's Pond.

Euglena sp (?). A few in one tow from the open lake. Abundant in filter paper collections, fewer numbers in the silk net, in all tows made throughout the period of study.

Euglena acus Ehr. Only a few individuals in scattered collections from Terwilliger's Pond. None recorded during the last few days in July.

Euglena deses Ehr. One specimen from Terwilliger's Pond.

Euglena spirogyra Ehr. One specimen from Fishery Bay. One from the open lake. Frequent in several tows from Terwilliger's Pond.

Euglena viridis Ehr. Frequent in scattered tows from Terwilliger's Pond.

Gonium pectorale Mull. Four colonies recorded from Terwilliger's Pond.

Pandorina morum Bory. Very frequent in two tows made in the open lake and Fishery Bay. Moderately abundant during the first part of July in Terwilliger's Pond. Exceedingly abundant in the same place during the latter part of July. In tows made on July 16, 24 and 26, a very large number of young colonies was noted, after which, the number of this species reached its height on July 27. Young colonies occurred frequently in one tow from Fishery Bay.

Peranema trichophorum Ehr. One specimen from Terwilliger's Pond.

Peridinium sp. (?). Numerous once in surface tow from Terwilliger's Pond on July 28.

Peridinium tabulatum Ehr. An occasional one from the open lake and Fishery Bay. Frequent irregularly during the latter part of July in Terwilliger's Pond.

Phacus longicaudus Ehr. Frequent in two filter paper catches from Terwilliger's Pond.

Phacus pyrum Ehr. Frequent irregularly in Terwilliger's Pond during the first part of July.

Phacus triqueter Ehr. Frequent in Terwilliger's Pond during the latter part of July.

Platydorina caudata Kofoid. A few colonies in all tows from Terwilliger's Pond during the latter part of July.

Trachelomonas acuminata Schmarda. One specimen from Fishery Bay. Numerous in nearly all of the tows from Terwilliger's Pond, increasing greatly in numbers during the latter part of July.

Trachelomonas armata Ehr. A few in three filter paper catches from Terwilliger's Pond.

Trachelomonas caudata Ehr. Three from Terwilliger's Pond.

Trachelomonas hispida Stein. A very few in two tows from Fishery Bay. Abundant during the first part of July in filter apper catches and increasing in numbers past the middle of the month. Decreasing somewhat in number toward the end of July.

Trachelomonas volvocina Ehr. Numerous in two filter paper catches from Terwilliger's Pond.

Volvox aureus Ehr. One colony from the open lake. Numerous colonies throughout the period of study in Terwilliger's Pond. Most of them were taken in the silk net.

CILIATA.

Amphileptus anser Ehr. One specimen taken in Terwilliger's Pond

Aspidisca costata (Duj). Several in a few tows from Terwilliger's. Pond.

Blepharisma musculus Ehr. Synonymous with *Uroleptus musculus* Ehr. of Butschli. A few scattered ones from Terwilliger's Pond.

Cinetochilum margaritaceum (Ehr.) Three recorded from Terwillig' er's Pond.

Codonella cratera (Leidy). A few from the open lake during the first two weeks of July. More numerous in tows from Fishery Bay, mostly in filter paper catches. Abundant in Terwilliger's Pond collections. Considerably more numerous in the tows made at night.

Coleps hirtus Ehr. Few in the silk net and numerous in filter paper catches from Terwilliger's Pond. This form occurred more or less spasmodically.

Colpoda sp (?). Frequent in one tow made in the first part of July in Terwilliger's Pond. An occasional individual after that and frequent again during the latter part of July.

Cyclidium glaucoma Ehr. Two from the open lake. Numerous in one filter paper catch from Terwilliger's Pond.

Dileptus gigus C. & L. One from Fishery Bay. One in a night tow from Terwilliger's Pond.

Frontonia sp. (?). A few specimens in a filter paper catch from Terwilliger's Pond.

Frontonia acuminata Ehr. A few in one tow from Terwilliger's Pond.

Glaucoma scintillans Ehr. A few in two tows from the open lake. More frequent in Fishery Bay.

Halteria grandinella O. F. Mull. An occasional individual in Terwilliger's Pond until the latter part of July, when the filter paper catches contained a few more.

Holophrya lieberkuhnii . A few in one Terwilliger's Pond tow.

Loxodes rostrum Ehr. Numerous individuals in one filter paper catch made at night from Terwilliger's Pond, during the first part of July. No more were seen again until the latter part of July when a few were noted from the same place in a night tow.

Oxytricha sp (?). Conn. A few occurred in two collections from Terwilliger's Pond.

Pleurotricha grandis Stein. One specimen in a night tow from Terwilliger's Pond.

Prorodon armatus C. & L. One specimen from Terwilliger's Pond.

Rhabdostyla sphæroides From. One was taken in a tow from Fishery Bay.

Stentor cæruleus Ehr. Frequent in one tow from Fishery Bay.

Trachelius ovum Ehr. A few specimens from Terwilliger's Pond.

Vorticella sp (?). An occasional specimen in night tows from Terwilliger's Pond.

Vorticella brevistyla D'Udk. One from the open lake.

Vorticella convallaria Linn., (Kent). A single specimen was recorded from Terwilliger's Pond.

Vorticella microscopica From. A single specimen occurred in a night tow made in Terwilliger's Pond.

PLANKTON TABLES.

FISHERY BAY Surface Plankton Protozoa Numbers are per cubic meter	Sky black, water very rough. Transp. 3′ 5″ Temp. 22° July 7 9 A. M.		Sky clear, water calm, slight breeze. Temp. 24° July 12 11 P. M.		Bright sunlight, water rippled. Preceding day, heavy rainstorm. Transp. 3′ 5″ Temp. 24° July 15 9 A. M.		Bright sunlight. Preceding day very rough. Transp. 3′ 6″ Temp. 24° July 16 4 P. M.		Heavy clouds, Water rough. Much rain preceding day. Transp. 2′ Temp. 22° July 19 11 A. M.		Bright sunlight, water rippled. Preceding day calm. Transp. 3′ Temp. 24° July 21 11 A. M.	
	Silk Net	Filter Paper	Silk Net	Filter Paper	Silk Net	Filter Paper	Silk Net	Filter Paper	Silk Net	Filter Paper	Silk Net	Filter Paper
Ameboid forms, minute	324000	825600	1200	24000	13200	10200	2040					
Arcella vulgaris Ehr									1			
Centropyxis aculeata Stein	30											
Cyphoderia ampulla Leidy									1			
Difflugia acuminata Ehr			1									11520
Difflugia corona Wallich							120				1	
Difflugia lobostoma Ehr	1020	2400	10200	25000	3190		13080		2600	14400	1430	8000
Euglypha ciliata Ehr									1			
Heterophrys (?) developmental forms(?)							120960					
Raphidiophrys viridis Archer									1			
Ceratium longicorne Perty		1	100	100							720	
Eudorina elegans Ehr		2400	500	1000	110		1560					3840
Euglena spp	60	19200									1	1
Euglena spirogyra Ehr											1	
Pandorina morum Bory				9600			2040*				110	19200
Peridinium tabulatum Ehr			2									
Trachelomonas acuminata Schmarda											1	
Trachelomonas hispida Stein											110	
Codonella cratera Leidy	60	9600	700	19200	110		120				330	
Dileptus gigus C. & L												
Glaucoma scintillans Ehr	360	4800	500	52800			600					
Rhabdostyla sphaeroides From			1									
Stentor caeruleus Ehr									200			

* Young colonies

PLANKTON TABLES—Continued.

TERWILLIGER'S POND Surface Plankton Protozoa Numbers per cubic meter	Sky black, water very rough. Transp. 15.5″ Temp. 22.5° July 8 9 A. M.		Sky clear, water calm. Temp. 26° July 12 10 P. M.		Bright sunlight, water disturbed by a stiff breeze. Transp. 9″ Temp. 25° July 15 9 A. M.		Bright sunlight, water calm. Transp. 10″ Temp. 25° July 16 4 P. M.		Sky clouded, preceding day stormy with heavy rains. Water full of silt and disturbed slightly. Transp. 9″ Temp. 22° July 19 11 A. M.	
	Silk Net	Filter Paper	Silk Net	Filter Paper	Silk Net	Filter Paper	Silk Net	Filter Paper	Silk Net	Filter Paper
Actinophrys sol Ehr.										
Ameboid forms, minute	12000	1300000			235	10000				
Arcella vulgaris Ehr.									280	
Centropyxis aculeata Stein.	33								1	
Difflugia acuminata Ehr.										
Difflugia corona Wallich.			200		1		240		280	
Difflugia lobostoma Ehr.	1100	2600	1700	14400	2492	25000	23040	6000	4060	19400
Difflugia lucida Penard.										
Difflugia pyriformis Perty.							480			
Euglypha ciliata Ehr.									1	
Heterophrys myriapoda Archer.										
Anthophysa vegetans Mull.		13000								
Ceratium longicorne Perty.										
Cryptomonas ovata Ehr.										
Dinobryon sertularia Ehr.								6000	280	
Distigma proteus Ehr.									1	
Eudorina elegans Ehr.	19000	97500	600		4781	20000	2640	24000	1400	36000
Euglena spp.	800	227500					720	48000	4320	771840
Euglena sp. (?)	200	26000	100		8032	300000			5180	28800
Euglena acus Ehr.	33	3250			96					11520
Euglena deses Ehr.										
Euglena spirogyra Ehr.	66	6500			191	2	480		280	51840
Euglena viridis Ehr.	33	3250				1000				
Gonium pectorale Mull.									1	
Pandorina morum Bory.	1300	110500	200		5068	75000	25920	438000	2940	372000
Peranema trichophorum Ehr.										
Peridinium sp. (?)										
Peridinium tabulatum Ehr.										
Phacus longicaudus Ehr.						1000				11520
Phacus pyrum Ehr.		3250							140	11520
Phacus triqueter Ehr.		19500			287				280	66080
Platydorina caudata Kofoid.										
Trachelomonas acuminata Schmarda.	100	58500		15000			720	36000	7980	504000
Trachelomonas armata Ehr.						1000			140	5760
Trachelomonas caudata Ehr.									1	2
Trachelomonas hispida Stein.		39000		1	287	35000	240	18000	140	80640
Trachelomonas volvocina Ehr.										
Volvox aureus Ehr.	3				670	1	960		420	3
Amphileptus anser Ehr.										
Aspidisca costata (Duj.)										1
Blepharisma musculus Ehr.										
Cinetochilum margaritaceum Ehr.								3		
Codonella cratera (Leidy)	200	19500	10300	230000	1912	15000	960	18000	3920	132480
Coleps hirtus Ehr.			800	55000			240		280	149760
Colpoda sp. (?)	400	19500	300							
Cyclidium glaucoma Ehr.				15000						
Dileptus gigus C. & L.				1						
Frontonia sp. (?) Conn.										
Frontonia acuminata Ehr.										
Hatteria grandinella O. F. Mull.						1	1			1
Holophrya lieberkuhnii										
Loxodes rostrum Ehr.										
Oxytricha sp. (?) Conn.										
Pleurotricha grandis Stein.										
Prorodon armatus C. & L.	1									
Trachelius ovum Ehr.										
Vorticella sp. (?)										
Vorticella convallaria Linn.										
Vorticella microscopica From.				1						

PLANKTON TABLES—Continued.

TERWILLIGER'S POND Surface Plankton Protozoa Numbers per cubic meter	Sky clear, water calm. Eel grass surface of pond. Transp. 10″ Temp. 25° July 21 11 A. M.		Bright sunlight, atmosphere hazy, sultry, water rippled. Transp. 9″ Temp. 28° July 23 3 P. M.		Sky with heavy clouds, water rippled. Temp. 25° July 23 10 P. M.		Sky clear, water slightly rippled. Temp. 24° July 24 4 A. M.		Sky clear, a few white clouds. Atmosphere clear. Water rippled. Transp. 16″ Temp. 20.5° July 26 9 A. M.		Sky clear. Water placid. Temp 22° July 26 10 P. M.	
	Silk Net	Filter Paper	Silk Net	Filter Paper	Silk Net	Filter Paper	Silk Net	Filter Paper	Silk Net	Filter Paper	Silk Net	Filter Paper
Actinophrys sol Ehr.						19200				800		
Ameboid forms, minute	1000			33600								
Arcella vulgaris Ehr.	1		200		100							
Centropyxis aculeata Stein.												
Difflugia acuminata Ehr.												
Difflugia corona Wallich.	1000		400		400		400				600	1
Difflugia lobostoma Ehr.	5000	16500	2600		1400		2000		3400		1000	14400
Difflugia lucida Penard.												
Difflugia pyriformis Perty.											1	
Euglypha ciliata Ehr.												
Heterophrys myriapoda Archer												
Anthophysa vegetans Mull.		22000		4800		9600						
Ceratium longicorne Perty			1						1		1	
Cryptomonas ovata Ehr.												
Dinobryon sertularia Ehr.		1 col.	800									
Distigma proteus Ehr.												
Eudorina elegans Ehr.	4200	27500	13800	67200	3400	28800	87800	28800	14200	129600	2400	139200
Euglena spp.	7800	577500	6400	105600	200	9600		1	4200	307200	1	1
Euglena sp. (?)	6600	49500	7000	4800	1400				400	4800		
Euglena acus Ehr.			1									
Euglena deses Ehr	1											
Euglena spirogyra Ehr.							1		600	9600		
Euglena viridis Ehr.	1800	16500										
Gonium pectorale Mull.			2	1								
Pandorina morum Bory.	3200	275000	7600	86400	1200	48000	117800	76800	17800	129600	2400	158400
Peranema trichophorum Ehr.									1			
Peridinium sp. (?)												
Peridinium tabulatum Ehr.				1						800		
Phacus longicaudus Ehr.									1	1		
Phacus pyrum Ehr.		5500		4800								
Phacus triqueter Ehr		5500		4800					200			
Platydorina caudata Kofoid.									200	1		
Trachelomonas acuminata Schmarda	3600	77000	9800	33600		9600			5200	100800	400	
Trachelomonas armata Ehr.		61000										
Trachelomonas caudata Ehr.												
Trachelomonas hispida Stein.	2000	181500	600	4800	200				200	4800		960
Trachelomonas volvocina Ehr.												
Volvox aureus Ehr	6		1600		1200		800		800		400	9
Amphileptus anser Ehr.	1											
Aspidisca costata (Duj.)			1		200			9600				336
Blepharisma musculus Ehr.		1						96				
Cinetoc hilummargaritaceum (E)												
Codonella cratera (Leidy)	5400	11000	3000	4800	4800	28800	9000	76800	4200	43200	1000	72000
Coleps hirtus Ehr.			400	4800	400		800	9600		1		
Colpoda sp. (?)		1		1		9600	200	9600				
Cyclidium glaucoma Ehr.												
Dileptus gigus C. & L.												
Frontonia sp. (?) Conn.			200									
Frontonia acuminata Ehr.												
Hatteria grandinella O. F. Mull.										1		
Holophrya lieberkuhnii												
Loxodes rostrum Ehr.											200	144
Oxytricha sp. (?) Conn.						96						
Pleurotricha grandis Stein.												
Prorodon armatus C. & L.												
Trachelius ovum Ehr.										1		
Vorticella sp. (?)						1		1				528
Vorticella convallaria Linn.								1				
Vorticella microscopica From.												

PLANKTON TABLES—Continued.

TERWILLIGER'S POND Surface Plankton Protozoa Numbers per cubic meter	Sky clear, water placid. Rays of sun not yet striking pond. Transp. 16″ Temp. 20.5° July 27 5:30 A. M.		Sun shining through white clouds. Atmosphere hazy. Transp. 16″ Temp. 24° July 28 11:30 A. M.		Sky with light clouds. Atmosphere hazy. Water placid. Transp. 17″ Temp. 26° July 28 6 P. M.		Sky clear, water undisturbed Temp. 24° July 29 4 A. M.		Sky clear, water slightly rippled. **Under bridge.** Current going out of pond. Transp. 16″ Temp. 23° July 30 10 A. M.		**Under bridge.** Current entering pond. July 30 10 A. M.	
	Silk Net	Filter Paper	Silk Net	Filter Paper	Silk Net	Filter Paper	Silk Net	Filter Paper	Silk Net	Filter Paper	Silk Net	Filter Paper
Actinophrys sol Ehr.						96000	150					
Ameboid forms, minute.							300		39			
Arcella vulgaris Ehr.							225				30	
Centropyxis aculeata Stein.							2	1				
Difflugia acuminata Ehr.							300		52		120	
Difflugia corona Wallich.	400				120		1800	96	1300		1800	48
Difflugia lobostoma Ehr.	400	144	400		5520	48	525	10560				
Difflugia lucida Penard.					2000	14400						
Difflugia pyriformis Perty.												
Euglypha ciliata Ehr.											1	
Heterophrys myriapoda Archer												
Anthophysa vegetans Mull.							1		2	1		
Ceratium longicorne Perty.												
Cryptomonas ovata Ehr.			50	38400	120							
Dinobryon sertularia Ehr.	1			1	1							
Distigma proteus Ehr.												
Eudorina elegans Ehr.	400	144	400		5520	48	1800	96	1300		1800	48
Euglena spp.	1	192	1000	7680	4000	388800	225		260	28800	180	17280
Euglena sp. (?).						48						
Euglena acus Ehr.												
Euglena deses Ehr.												
Euglena spirogyra Ehr.	1	1							1			
Euglena viridis Ehr.												
Gonium pectorale Mull.												
Pandorina morum Bory.	15400	1103600	1600	48000	1800	940800	3300	227040	910	64900	480	30240
Peranema trichophorum Ehr.												
Peridinium sp. (?).					1080	38400						
Peridinium tabulatum Ehr.			200	9600								
Phacus longicaudus Ehr.												
Phacus pyrum Ehr.				1								
Phacus triqueter Ehr.												
Platydorina caudata Kofoid.			20		400	96	150	48	65			
Trachelomonas acuminata Schmarda.	800	19200	800	38400			150		130	21600		
Trachelomonas armata Ehr.												
Trachelomonas caudata Ehr.												
Trachelomonas hispida Stein.	200	9600	1000	43200	120	24000	150			48		
Trachelomonas volvocina Ehr.												
Volvox aureus Ehr.	600		400		1320		75				1	
Amphileptus anser Ehr.												
Aspidisca costata (Duj.).												
Blepharisma musculus Ehr.			25	1	120				1			
Cinetoc hilummargaritaceum (E)												
Codonella cratera (Leidy).	2200	38400	1600	14400	3600	192	5400	26400	130		600	
Coleps hirtus Ehr.						48						
Colpoda sp. (?).						624	150					
Cyclidium glaucoma Ehr.												
Dileptus gigus C. & L.												
Frontonia sp. (?) Conn.												
Frontonia acuminata Ehr.						100						
Hatteria grandinella O. F. Mull.						1776		96		48		
Holophrya lieberkuhnii.						144						
Loxodes rostrum Ehr.								48				
Oxytricha sp. (?) Conn.										48		
Pleurotricha grandis Stein.							1					
Prorodon armatus C. & L.												
Trachelius ovum Ehr.						96						
Vorticella sp. (?).			1			48		1	3			1
Vorticella convallaria Linn.												
Vorticella microscopica From.												

PLANKTON TABLES—Continued.

OPEN LAKE Surface Plankton Protozoa Numbers are per cubic meter	Sky black, water very rough. Transp. 3′ 5″ Temp. 22° July 7 8 A. M.		Sky clear, water calm, very slight breeze. Temp. 23° July 12 10:30 P. M.		Bright sunlight, water very rough. Transp. 3′ 5″ Temp. 23° July 15 9 A. M.		Bright sunlight, water very calm. Transp. 3′ 6 Temp. 23° July 16 4 P. M.		Bright sunlight, long rolling Waves. Transp. 3′ Temp. 24° July 21 11 A. M.	
	Silk Net	Filter Paper	Silk Net	Filter Paper	Silk Net	Filter Paper	Silk Net	Filter Paper	Silk Net	Filter Paper
Ameboid forms, minute	Abdt.	Abdt.	6000	.....	3000	145000	.....	.....	.....	.....
Arcella vulgaris Ehr.	.....	.....	1	.....	1	.....	.....	.....	.....	.....
Centropyxis aculeata Stein	.....	1	.....	.....	.....	.....	.....	.....	.....	.....
Difflugia corona Wallich	.....	.....	.....	.....	100	.....	.....	.....	.....	.....
Difflugia lobostoma Ehr	1120	24000	5200	.....	2700	15000	4060	.....	1200	6720
Ceratium longicorne Perty	70	1440	.....	.....	.....	.....	.....	.....	.....	.....
Dinobryon sertularia Ehr	6	.....	.....	.....	.....	.....	.....	.....	.....	.....
Eudorina elegans Ehr	210	14400	900	.....	.....	35000	960	.....	480	3360
Euglena sp. (?)	.....	6240	.....	.....	.....	.....	.....	.....	.....	.....
Euglena spirogyra Ehr	.....	1	.....	.....	.....	.....	.....	.....	.....	.....
Pandorina morum Bory	.....	2880	.....	.....	.....	.....	.....	.....	.....	20160
Peridinium tabulatum Ehr	.....	.....	.....	.....	2	.....	240	.....	.....	.....
Phacus pyrum Ehr	1	.....	.....	.....	.....	.....	.....	.....	.....	.....
Volvox aureus Ehr	.....	1	.....	.....	.....	.....	.....	.....	.....	.....
Codonella cratera (Leidy)	18	2880	100	.....	100	.....	240	.....	.....	.....
Cyclidium glaucoma Ehr	2	.....	.....	.....	.....	.....	.....	.....	.....	.....
Glaucoma scintillans Ehr	.....	.....	300	.....	100	35000	.....	.....	.....	.....
Vorticella brevistyla D'Udk	1	.....	.....	.....	.....	.....	.....	.....	.....	.....

OBSERVATIONS ON THE DIURNAL MIGRATION OF THE SURFACE PLANKTON PROTOZOA.

It is interesting to note that in the tow made at 10 P. M., July 12, at 11 P. M., July 23, at 4 A. M., July 29, and at 10 P. M., July 30, the predominating Protozoa were rhizopods and ciliates, in other words, they were mostly holozoic forms. A few colonial flagellates that were so abundant in the water during the day time were present only in small numbers in the night tow.

The ciliates, *Codonella cratera* (Leidy) and *Coleps hirtus* Ehr., occurred much more abundantly in night tows than in tows made during the day time.

I believe that it can be said that the chlorophyll bearing forms were present in greatest numbers at the surface between three and five o'clock in the afternoon.

It may be noted that in the collections made under the bridge connecting Terwilliger's Pond and Fishery Bay, the tow made while the water flowed out of the pond contained more than twice as many protozoan organisms as the tow made while the current flowed from Fishery Bay into the pond.

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CHANGE IN THE PUBLICATION DATES OF THE OHIO JOURNAL OF SCIENCE.

Hereafter the OHIO JOURNAL OF SCIENCE will appear bi-monthly throughout the year. Each volume will consist of six numbers as follows: 1, January-February; 2, March-April; 3, May-June; 4, July-August; 5, September-October; 6, November-December.

The editor hopes to have each number appear at the end of the first month in the respective groups.

Each number will consist of approximately fifty pages. The total number of pages per volume will thus be about the same as it has been in the past.

THIRTY-THIRD ANNUAL MEETING

OHIO ACADEMY OF SCIENCE

At a meeting of the Executive Committee of the Ohio Academy of Science, held in Columbus, October 21, 1922, it was voted to accept the invitation of Oberlin College to hold the next Annual Meeting in Oberlin. The date of the meeting was fixed for Friday and Saturday, March 30 and 31, 1923.